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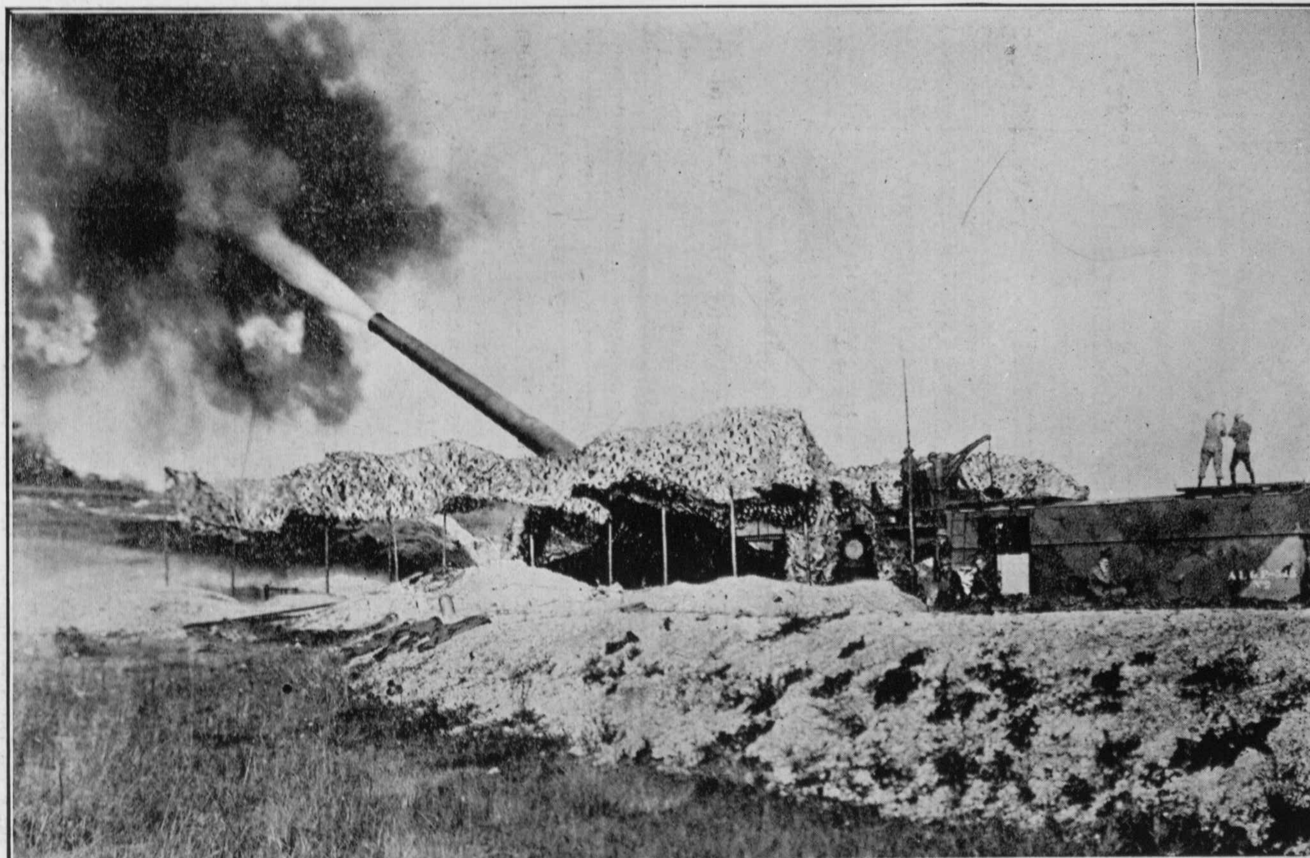


Battery D, 53d Coast Artillery, manning a French 340-mm. gun in action near Verdun, September, 1918

The Coast Artillery Journal

Vol. 61 No. 2 AUGUST, 1924 Whole No. 216

The American Expeditionary Force to Siberia

By Brigadier General W. S. Graves, *U. S. Army*

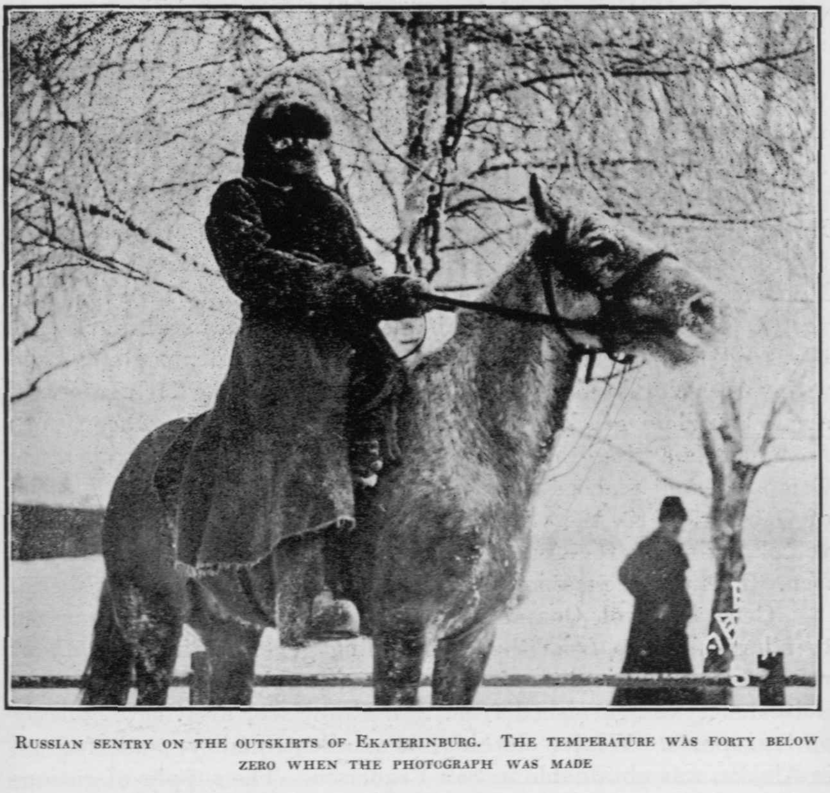
THE demoralization in the Russian Army after the fall of the Czar of Russia finally resulted in American and Allied troops being sent to Siberia. There was naturally great anxiety on the part of the Allies as to the effect this demoralization in the Russian forces would have on the Allied cause. It was a delicate question that had to be considered from all angles. Russia had mobilized a larger force than any other nation. Her losses had been more than any other nation. These sacrifices entitled her to the greatest consideration from a moral standpoint, as well as self-interest of the Allies. If her territory was ruthlessly invaded against the overwhelming sentiment of the Russian people, there was grave danger that the Allies would lose not only the sympathy of the Russian people but their moral and material assistance. It was to be expected that Germany would present, by propaganda, to the Russian people the claim that Russian territory had been invaded by the Allies and would never be given up. This propaganda would probably have been very effective if only one Allied nation sent troops to Siberia. The Allies were not unanimous as to the best course to follow in Russia. Some advised the organization of a military force composed principally of Russians, with the object of exerting pressure against Germany from the east, thereby lessening pressure against the Allies on the western front. This was logical only on the assumption that the Russians were still willing to fight wholeheartedly for the Allied cause.

The line of communications from any seaport base to troops operating against Germany from Russian territory was too long to make this plan practical, except through territory of Allies whose hearts were in the war. The Allies could not be sure of the attitude of the Russian people. This plan was finally dropped. Subsequent information has shown, however, that the Allies favoring an eastern front did not abandon their plans, but hoped to accomplish their

ADMIRAL KOLCHAK, WHO WAS SUPREME DICTATOR OF SIBERIA FROM NOVEMBER 18, 1918 UNTIL HE WAS MADE A PRISONER JANUARY, 1920. HE WAS KILLED IN FEBRUARY, 1920

object by reaching the eastern front through another door. Early in 1918 the claim was generally made that the Russians had released the German and Austrian prisoners, who had been sent to Siberia for confinement, and that these prisoners were organizing a military force with the object of taking the military stores stored at Vladivostok, by the Czar's government, and sending them to Germany. A claim was also made that the Russians were preventing the Czechs, who had left the Austrian Army, from passing through Siberia on their way to the western front to join the Allies. It is now well established that there was no danger from the German and Austrian

prisoners, who had been confined in Siberia. I believe it is almost as well established that what differences arose between the Czechs and Russians, during the passage of the Czechs through Siberia, had no relation to the desire of the Czechs to join the Allies on the western front. While the United States had definitely declined, as long as the military situation on the western front remained critical, to send any part of its military force to Russia, it did consent, on account of



RUSSIAN SENTRY ON THE OUTSKIRTS OF EKATERINBURG. THE TEMPERATURE WAS FORTY BELOW ZERO WHEN THE PHOTOGRAPH WAS MADE

representations relative to the Czech and German and Austrian prisoners above referred to, to join Japan in sending a small force to Vladivostok to guard Russian military property stored there, and to help the Czecho-Slovaks consolidate their forces. The small force above mentioned was to consist of ten to twelve thousand men. Other Allies, if necessary, were to send a small force to Vladivostok. In order that no one in Russia or elsewhere could question the good faith and sincerity of the United States, when it joined the Allies in sending a small force to Siberia, the United States asked all associated in this action "to unite in assuring the people of Russia,

in the most public and solemn manner, that none of the governments uniting in action in Siberia or in northern Russia contemplates any interference of any kind with the political sovereignty of Russia, any intervention in her internal affairs, or any impairment of her territorial integrity now or hereafter . . ." These announcements guided American troops in their action towards the Russians during their entire Siberian service. It will be seen that this announced policy, which appeared in my instructions, is not consistent with the too prevalent belief that American troops went to Siberia to fight Bolshevism.

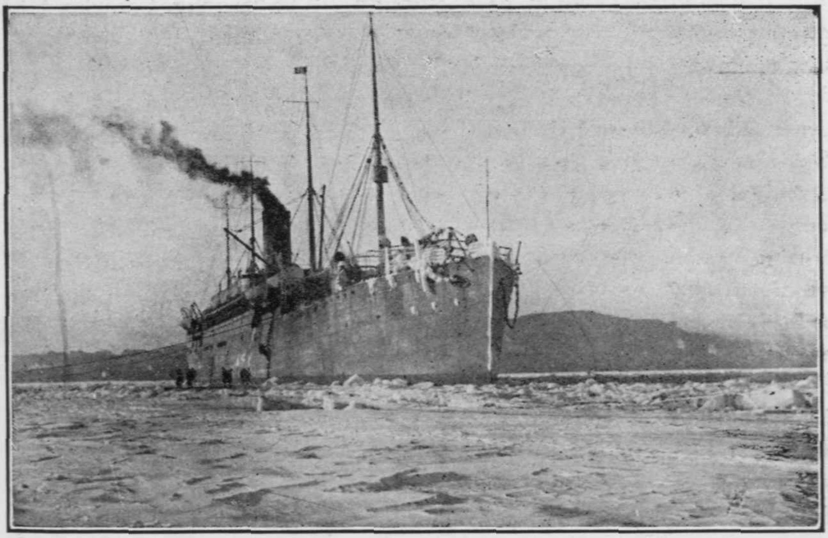
On August, 3, 1918, the commanding general, Philippine Department, was directed, by cable, to send by the first available United States Army transports the following troops to Vladivostok for station: The 27th and 31st Infantry regiments, one Field Hospital, one Ambulance Company and Company "D", 53rd Telegraph Battalion, provided with equipment, winter clothing and authorized transportation. The commanding general, 8th Division, Camp Fremont, California, was directed August 4, 1918, to send to Vladivostok, Siberia, by the first available United States transports, five thousand men selected from the 8th Division, fully equipped and with winter clothing. The first American troops, the 27th Infantry, arrived at Vladivostok from Manila, August 15th. The other troops from Manila arrived three or four days later. The first troops from Camp Fremont reached Vladivostok September 2, 1918. By the end of October, 1918, the various organizations had arrived in Vladivostok, bringing the American force to about 10,500 officers and men. This was the maximum number of American troops in Siberia.

General Devol, Quartermaster, San Francisco, was authorized to fill requisitions from the commanding general, Siberia, without reference to Washington. The system of supply was well organized. Subsistence was furnished from San Francisco, arriving regularly on transports. Winter clothing, of excellent quality, made for use in Alaska, was obtainable in San Francisco. The supply of rations and clothing in quality and kind left nothing to be desired. The wheel transportation supplied infantry organizations was too heavy for operations in Siberia. The roads and bridges were built for use by the Russian cart, drawn by one horse. Army wagons mired and were too heavy for bridges.

Duties of Troops in Siberia

There were three distinct phases governing the work of troops in Siberia. The first phase was from arrival to the signing of the Armistice November 11, 1918. During this phase American troops

were used in conjunction with Allied troops in operations against an armed force. This armed force was represented as being composed partly at least of German and Austrian prisoners. The objective of these forces was represented as being the Russian stores at Vladivostok. I now think it was a clash between Russian factions for control of Russian governmental machinery and had no relation to the property at Vladivostok. As commander of American troops, I felt justified in taking part in offensive operations against these organizations because of our belief that they were often officered by German officers. Subsequent to the signing of the Armistice, I



AMERICAN TRANSPORT ANCHORED IN VLADIVOSTOK HARBOR MARCH 30, 1920. THE SICK WERE CARRIED FROM THE HOSPITAL TO THIS SHIP BY LITTER BEARERS WALKING ON THE ICE

refused to permit American troops to take part in any conflicts, except for our own protection and for the protection of property under guard of American troops. I mention this particularly, because American troops have been charged with inconsistency, because they took part in operations against Russians during a part of our stay in Siberia and later would not join Russians in fighting so-called Bolsheviks. The second phase of our work extended from the signing of the Armistice to about April, 1919. During this period American troops were employed in guarding Russian property, and helping keep the railroads in operation. This was prior to the signing of the railroad agreement spoken of later. In February, 1919, the various governments having troops in Siberia signed the railroad agreement. The governments joining in this

agreement were the United States, Japan, England, France, Italy, China and Russia as represented by the Kolchak government. The Czechs were not a party to the agreement, but took a prominent, and I might say a dominant part in the guarding of the railroad. This agreement provided for the management, operation and guarding of the railroads outside of the zone of military operations. The agreement was designed to help all the Russian people by keeping the railroads in operation, so that supplies could be sent to all Russians within reach of the railroad. This agreement provided that the chairman of the Interallied Railway Committee, which was the managing committee, should be a Russian. The practical working of the agreement proved to be a great disappointment. Admiral Kolchak immediately appointed his Minister of Communications as chairman of the committee. The management and operation of the railroads had been, prior to the agreement, and were at the time of agreement entirely in the hands of Russians in sympathy with Admiral Kolchak. There was no way to get rid of these railroad employes, even if the Allied representatives had so desired. There was no way to force the Russian railway men to comply with suggestions or instructions of foreign technical railway men, sent to Siberia to help operate the railroads. The operation of the railroad rested entirely in the hands of Russians. The head of this railroad force was Admiral Kolchak's Minister of Communications. A Russian military officer was made station commandant at all stations. Instead of the railroad being operated for the benefit of the Russian people as a whole, it became purely a military road operated in the interest of the Kolchak forces. The guards had no duties in connection with the railroad, except to see that passengers and supplies reaching their sector were not molested while in their sector. The railroad employes and the Kolchak military took measures to see that no supplies except those destined to Kolchak adherents and no passengers except Kolchak sympathizers were permitted on the railroad. Unfortunately, this placed the Allied military guards in the position of helping one of the contending factions. The Kolchak troops were kept in the towns on the railroad. Generally speaking, some foreign troops were in the same towns. The troops opposed to Admiral Kolchak were in country villages off the railroad. The latter could not take action against Kolchak forces without interfering with the railroad, which the Allied troops could not permit. Those opposed to Admiral Kolchak soon determined that the successful prosecution of their cause made it necessary to interfere with the operation of the railroad, which was Admiral Kolchak's line of communications. These attacks on the railroad brought foreign

troops in conflict with Russians. The American troops remained on duty guarding the railroad until January, 1920, when orders were received to assemble all troops in Vladivostok with the object of sending them to Manila. The last of our troops sailed from Vladivostok on April 1, 1920.

Siberia and its Resources

The people of the United States know very little of the size, the fertility of the soil or the resources of Siberia. The distance from

Allied detachments forming in the square in front of the railway station at Vladivostok, for an allied parade, previous to dedication of Czech monument, Vladivostok, May 1

Vladivostok to the Ural Mountains, the western boundary of Siberia, is about four thousand miles. Siberia is one and one-half times as large as the United States proper. There is a great variety of terrain. In passing from Vladivostok to Omsk, on the Trans-Siberian railway, a distance of about 3600 miles, one passes through flat, rolling and mountainous country. Some parts of the country are covered with valuable forests. There are about fifty varieties of timber in Siberia, of which the most valuable are oak, ash, walnut, birch, aspen, maple, elm, cedar, pine and fir. Numerous deposits of platinum, gold, silver, lead and iron have been found in Siberia. Generally speaking, the soil is very fertile and is especially rich in

producing small grain. Uncultivated grass land and other vegetation conclusively prove the richness of the soil.

The internal conflict between Russian factions has resulted, in my judgment, in giving our people an erroneous impression of the great mass of Russians. The Russian peasant impressed me as being kind, hospitable and generous. I made a close study of the Siberian people, not only because it was my duty, but because it became an extremely interesting study. The peasants constituted about 85 per cent of the people. These peasants had a deep-seated conviction that the Czar's government was not in the interest of all the Russian people. Their vision as to governmental affairs was naturally very limited. They had little interest in international affairs. Their interest in national affairs extended only to questions of immediate and pressing interest to them. They resisted mobilization for the purpose of fighting for Admiral Kolchak. They undoubtedly feared that Admiral Kolchak intended to establish a government very similar to the Czar's government. There were many acts of the Kolchak military representatives that justified the peasants in this belief. It seemed impossible for the Cossacks to realize that the day had passed when their power could be exercised in the same way it had been exercised under the Czar. Many of the officials of Kolchak acted as if they thought force alone would appeal to the peasants. They had failed to understand the true meaning of the unrest in the peasant class during the past generation. Every Russian who objected to mobilization or who questioned the object of the Kolchak representatives was classed a Bolshevik. By May of 1919, the sentiment had crystallized so that there were only two classes of Russians in Siberia, Bolsheviks and Anti-Bolsheviks. Men were classified as Bolsheviks not because of their actions but because of their political beliefs. In the United States there was a great stigma attached to the designation Bolshevik. This was particularly true when this designation was applied to a Russian. Because the peasants of Siberia did not approve of Admiral Kolchak, or more correctly speaking, did not approve of the people surrounding Admiral Kolchak, they were called Bolsheviks and pictured by many of our people as being men with a torch and bomb trying to destroy civilization. We pictured them in the same class as our few anarchists. They are just as far from the anarchists as are our farmers who spend their time in trying to make an honest living by tilling the soil. This relates solely to Siberia and has no reference to European Russia, of which I have no knowledge of conditions.

Preparation and Adjustment of Fire

Honorable Mention, Prize Essay Competition, 1923

By MAJOR E. L. KELLY, C. A. C.

PREPARATION and adjustment of fire is a subject of importance to all artillerymen. Knowledge of this subject should not be limited to that involving one type of cannon or fire at a particular kind of target, because sooner or later each of us will be confronted with other variations of the problem. An understanding of the basic problem is essential to a complete understanding of any particular variation of it. The basic problem is that which involves indirect fire at a moving target which is changing simultaneously in both range and direction from the firing battery, the firing battery being cannon of any type—fixed or mobile, guns, howitzers or mortars.

Variations from these conditions, such as direct fire or fire at a stationary target, are simple special cases of the basic problem and should not be regarded as separate problems. Preparation and adjustment of fire for a battery of 12-inch railway mortars firing over land at a cross-roads behind a hill is not a different problem from that of a fixed seacoast gun battery firing over water at a visible moving target. They are both merely variations of the same problem. The best solution for the whole problem of preparation and adjustment of fire would be a simple system for the solution of the basic problem, uniform for all types of cannon and applicable to any variation from the basic problem simply by the omission of some of the operations of the system.

A study of old target practice reports shows how well the problem of preparation and adjustment of fire has been solved in the past. Such a study has been made in one coast artillery district, the study including a compilation of data from the reports of twenty batteries during a period of seven years. This compilation and study have resulted in deductions and conclusions which point to a solution of the problem of preparation and adjustment of fire different, in some respects, from solutions which have been attempted in the past and at variance with the theories held by some artillery authorities.

Before going into a discussion of the conclusions deduced and their bearing on the problem of preparation and adjustment of fire, a brief statement of some of the data is given as being of possible interest.

1. The average personnel error per shot was, for 12-inch mortars, 34 yards (1258 shots considered), for 6-inch guns 45 yards (845 shots) and for 14-inch guns 86 yards (414 shots).

2. The percent of shots within fifty yards of the target was, for 12-inch mortars 31 percent, for 6-inch guns 25 percent and for 14-inch guns 25 percent.

3. The developed probable error was, for 12-inch mortars about 50 yards, for 6-inch guns about 80 yards and for 14-inch guns about 80 yards.

4. The data show no consistent increase of the probable error with increase of range and no great differences between batteries.

5. The muzzle velocity assumed for trial shots, based on the deviations in a previous practice with the same lot of powder, was seldom even approximately the same as the so-called "muzzle velocity determined from the deviations of trial shots," and the muzzle velocity determined from the deviations of trial shots fired at a fixed point was seldom the same as the muzzle velocity developed from the deviations of the subsequent record shots at a moving target.

The data and study of the records led to the following conclusions relative to fire on moving targets:

1. It is unsound to apply a correction on the muzzle velocity curves of the range correction board based on a muzzle velocity determined from the deviations of previous shots, whether they be ranging shots, trial shots or shots of a previous series or practice.

2. Adjustment corrections applied as flat corrections to the firing data will not put the center of impact on the target and keep it there.

3. The developed armament probable error, as deduced by the present method of analysis of target practice, is not the true armament probable error.

4. The greatest obstacle to proper adjustment of fire is the effect of unknown atmospheric conditions.

The first of the above conclusions is in direct contradiction to the method of correction which was prescribed as compulsory in the Coast Artillery some years ago, and is at variance with the published opinion of the Coast Artillery Board that such corrections are warranted. This conclusion is of importance not only as applied to the trial shot method of adjustment but also in its bearing on the whole problem of preparation and adjustment of fire.

It is not desired to burden the reader with long lists of data, but one page of data is given at this point for such reference as may be desired in connection with the following example, given to show the absurdity of applying, on the velocity curves, corrections based on deviations.

14-INCH GUNS

Battery	Date	Powder and Weight	Trial Shots Muzzle Velocity		Record Shots Muzzle Velocity		Aver. M.V. Devel.
			Assumed	Developed	Assumed	Developed	
A	July 7, 1916	P.A.	2250	2275			
A	July 12	133	2300	2235	2235	2270	
B	July 12	Wt.	2250	2233	2233	2257	
D	July 17	379 lb.	2235	2275	2275	2264	
D	Aug. 2	6 oz.			2240	2256	
A	Aug. 8		2235	2272	2272	2292	
B	Aug. 8		2250	2230	2230	2241	
D	Nov. 9				2250	2258	2258
A	Oct. 31, 1917		2250	2250			
B	Oct. 31		2230	2270			
C	Oct. 31		2250	2262			
D	Nov. 8		2260	2258	2258	2236	
E	Nov. 9		2230	2205	2205	2200	
A	Nov. 13		2250	2250	2250	2233	
B	Nov. 14		2260	2260	2260	2262	
C	Nov. 15		2255	2260	2260	2265	2247
B	May 5, 1918		2260	2261	2261	2265	
E	June 14		2205	2225	2225	2212	
B	July 24		2260	2266	2266	2241	
E	Sept. 4		2215	2232	2232	2226	
E	Dec. 9, 1921				2220	2253	2242
							2250
A	May 1, 1918	P.A.	2260	2247	2247	2243	
C	May 8	134	2250	2242	2242	2247	
F	June 6	Wt.	2250	2254	2254	2273	
D	June 19	386 lb.	2250	2255	2255	2256	
A	July 25		2250	2250	2250	2248	
F	Sept. 19		2208	2248	2248	2246	2251
A	Dec. 3, 1920				2265	2241	
C	Dec. 10				2255	2247	
A	Dec. 28				2250	2243	
C	Dec. 29				2250	2258	2247
C	Jan. 3, 1921				2260	2247	
F	Dec. 10				2280	2230	2230
							2247
A	Jan. 3, 1921	P.A.			2250	2292	
A	Jan. 4	196			2292	2274	
C	Jan. 4	Wt.			2290	2278	
A	Jan. 5	419 lb.			2290	2274	
C	Jan. 5				2290	2298	
B	Aug. 26				2250	2275	
E	Nov. 28, 1922				2250	2291	
E	Dec. 7				2290	2293	2284
A	Nov. 9, 1922	Wt.			2250	2266	
B	Nov. 9	412 lb.			2250	2280	
F	Nov. 28	14 oz.			2250	2239	
A	Dec. 5				2273	2267	
F	Dec. 7				2255	2264	
B	Dec. 9				2280	2259	2262

On July 12, 1916, Battery A and Battery B, which are adjacent batteries, each fired three trial shots at a fixed point, 10,000 yards range, and then five record shots each at a moving target. Both used the same lot of powder which had been stored the same length of time under the same conditions in adjoining magazines. For the trial shots A assumed a muzzle velocity of 2300 f.s., "taken from the records of the firing at this battery on July 7, 1916." (Quoted from the records of the practice). B assumed a muzzle velocity of 2250 f.s. (normal) "this velocity having been fixed as a result of proof firing a short time previous."

The muzzle velocity determined from the trial shots was for A 2235 f.s. and for B 2233 f.s. Corrections were applied on the velocity curves and then both batteries fired the record shots at a moving target. The muzzle velocity determined from the deviations of the record shots was, for Battery A, 2270 f.s., and for Battery B, 2257 f.s. Battery A fired at a mean azimuth of 34.30 degrees and at a mean range of 10,905 yards, and B at a mean azimuth of 333.66 degrees and at a mean range of 11,156 yards—a difference of 60 degrees in direction of fire and of only 280 yards in range.

One month later these two batteries again fired three trial shots and four record shots each. The muzzle velocities determined from the trial shots were, for Battery A, 2272 f.s. and for Battery B, 2230 f.s. Those determined from the record shots were, for Battery A, 2292 f.s. and for Battery B, 2241 f.s. The difference in direction of fire was 82 degrees and in range 170 yards.

Summarizing, at two batteries which are adjoining, with the same lot of powder, same weight of charge, powder of the same temperature and stored under the same conditions, both batteries firing the same number of shots at approximately the same ranges on each of two days less than a month apart and the only difference being that of *direction of fire*, the following so-called "muzzle velocities" were determined: 2233, 2235, 2270, 2257, 2272, 2233, 2292 and 2241 f.s. Such a variation in the muzzle velocity developed by one lot of powder within one month is of course impossible and it is evident that the deviation of the center of impact is not due to variations in muzzle velocity. It is therefore unsound to apply on the velocity curves corrections based on deviations. The fact that the distance of the center of impact from the target varies for different days and at the same hour for different directions is conclusive evidence that the variations are caused by atmospheric conditions, principally wind effects which are unknown and uncorrected for.

To show how great an error may be introduced by applying correction on the velocity curves instead of on wind curves the fol-

lowing readings, taken from the latest range correction charts for 14-inch guns, are given: a correction of 370 yards at 20,000 yards on the velocity curves gives at 10,000 yards on the same velocity curve a correction of 210 yards. A similar correction of 370 yards at 20,000 yards applied on the wind curves gives at 10,000 yards on the same wind curve a correction of only 90 yards. Between the two methods of applying the correction there may therefore result a difference of 120 yards which is equal to one and one-half probable errors for this gun.

Adjustment corrections applied as flat corrections to the firing data will not, in the general case, put the center of impact on the target and keep it there. Adjustment corrections are based on the deviations of previous shots and they therefore correct only for the conditions that were existing at that time and at the range and direction of the previous shots. By the time the next shot is fired, the effect of the unknown wind for the new range and for the new direction of fire will be different and the flat correction will not apply. No lengthy discussion of this point is necessary, but it is desired to emphasize the point that it is the effect of the unknown wind that makes a flat correction inapplicable.

The developed armament probable error, as deduced by the present method of analysis of target practice, is not the true armament probable error. As now deduced in the analysis of target practice the developed armament probable error is based on the "deviations that would have resulted had no arbitrary corrections been ordered and no personnel errors made." This is on the assumption that these deviations represent the deviations due to armament. This assumption is erroneous because these deviations are due to the unknown and uncorrected for wind effects as well as the errors of armament. The following data are taken from the records of a practice held in 1922 at a 14-inch gun battery: Deviations that would have resulted had no arbitrary corrections been ordered and no personnel errors made +625, +425, +370, +124, +132 yards; distance armament center of impact from target +333 yards; developed armament probable error 137 yards.

In Fig. 1, the points T_1, T_2, etc., represent the positions of the target, plotted on lines representing the azimuths of the direction of fire of the successive shots. The points D_1, D_2, etc., represent the "deviations that would have resulted had no arbitrary corrections been ordered and no personnel errors made." The line C-C_1 represents what may be called the axis of the center of impact (333 yards from the target line T_1-T_5). The distance of each D point from the line C-C_1, represents, according to the present method of analysis;

the armament error for that shot and the "Developed armament probable error" is deduced from the mean of these errors. It is held that this is erroneous. The line A-A_1, is drawn so that the sum of the distances from it of all D points below it, is equal to the sum of the distances from it of all D points above it, and so that these sums are their minimum value. It is held that this line represents the true axis of the armament center of impact, that the true armament error of each shot is the distance from this axis of the corresponding D point and that the true developed armament probable error should be based on these values. The inclination of the A-A_1 axis to the C-C_1 axis is due to the effect of the unknown and uncorrected wind, and the diagram shows that this effect—that is, the range com-

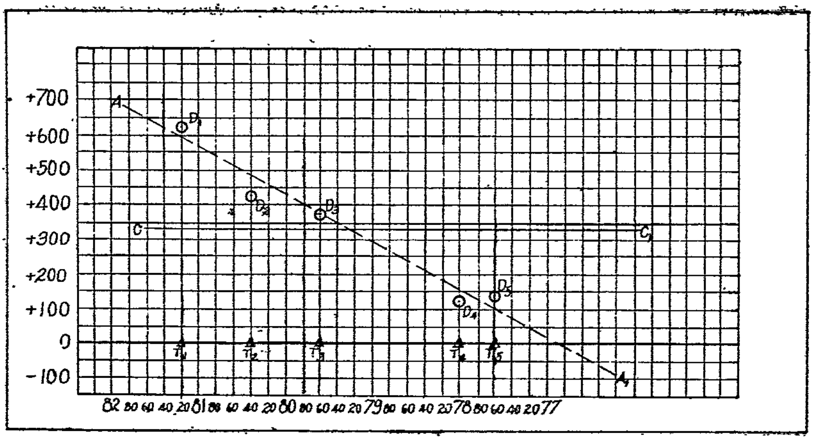


FIG. No. 1

ponent of the wind—changed as the direction of fire changed. It is held that the distance from each T point to the axis A-A_1 is the deviation due to the unknown wind and that this deviation should not be charged to armament. This faulty analysis has resulted in excessive "developed armament probable errors" and it explains also why the probable error developed at one practice was different from the probable error developed at another practice at the same battery. The effect of the unknown wind has been included in the armament error and of course the effect of the unknown wind is different for each practice. A study of the diagram shown in Fig. 1 will show also why flat corrections will not put the center of impact on the target and keep it there. Fig. 2 is similar to Fig. 1, the data being taken from the records of a 12-inch mortar target practice.

The data compiled from the records of target practices of twenty batteries during a period of seven years, the study of the

data and records and the deductions made therefrom all point to the fact that for many years our artillery authorities have attached too much blame for deviations to the armament—specifically to the powder, through widely varying so-called "determined muzzle velocities"—and not enough blame to the effect of wind, to which practically all the blame belongs. During the past year some artillerymen have advocated percentage corrections. The theory of percentage corrections is simply a compromise between the theories of correction on the velocity curves and of correction on the wind curves.

Based on the above discussion, it is claimed that correction on the velocity curves is unsound, that the compromise of percentage

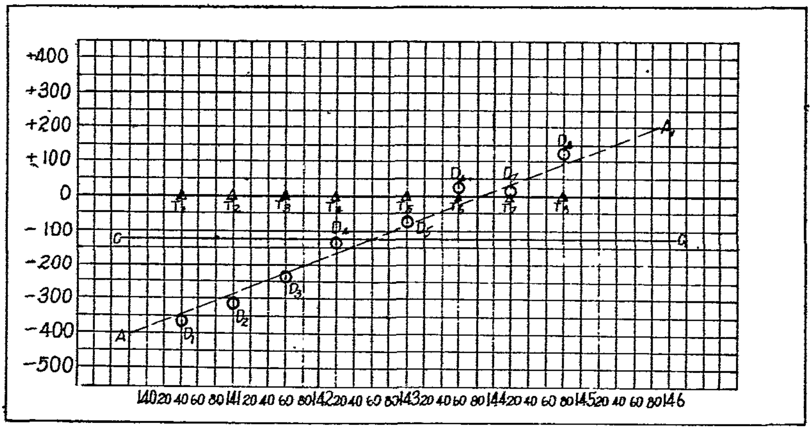


FIG. No. 2

corrections is unwarranted and that adjustment corrections, based on deviations, should be applied on the wind curves. These conclusions are the basis of the following discussion of the general problem of preparation and adjustment of fire.

PREPARATION OF FIRE

In preparation of fire, corrections should be made for those conditions and elements which can be measured and the effect of which can be computed or predicted before firing begins. These conditions and elements are height of site, travel of the target, muzzle velocity, atmospheric density and drift.

Correction for height of site as made at present is satisfactory and need not be discussed. Correction for travel is included in plotting and need not be discussed.

The actual muzzle velocity given by the powder can be determined by measurement—by proving ground methods—or it may be determined approximately by deduction from the records of pressures developed. Powder is a concrete substance and its properties cannot only be determined by measurement, but can be regulated in manufacture. Care should be given in its manufacture to secure uniformity and the muzzle velocity given by a charge of a certain weight should be accurately measured. This muzzle velocity will not change from hour to hour, from day to day, or even from year to year except slightly due to deterioration which can also be determined from the records of pressures developed. The temperature of the powder at the time of firing can be measured and a velocity correction for it determined accurately as at present. The following solution of the muzzle velocity problem is proposed:

a. Establish a "Central Powder Desk," over which the reports of all firings will pass and where the data on powder will be compiled, including the data on pressures and the so-called muzzle velocities determined from deviations. The data on pressures will show when a lot of powder is becoming dangerous, and from the pressures the muzzle velocities may be deduced. The mean of a number of muzzle velocities determined from deviations will give roughly the most probable value of the muzzle velocity which can be used as a check on the velocity deduced from pressures. These data will show when there is a considerable and consistent variation from the normal and it can be determined whether or not the normal velocity or weight of charge as given by the Ordnance Department is in error. It is believed that with the records of all firings passing over the Central Powder Desk, sufficient data will be obtained to permit a curve of muzzle velocities to be plotted for each lot, which will show the behavior of the powder and its deterioration from year to year and will permit the prediction of the muzzle velocity for the following year.

b. When the data shows that the weight of charge is in error, the Ordnance Department should be requested to again measure by proving ground firings the muzzle velocity for that lot and determine the correct weight to give the normal velocity.

c. Issue to the service at the beginning of each year a bulletin giving for each lot of powder in use the correct muzzle velocity or, preferably, the proper weight of charge to give the normal velocity.

d. At all target practices and service firings, assume the normal muzzle velocity for the weight of charge given, or use the weight or muzzle velocity announced from the "Central Powder Desk."

Atmospheric density can be measured and corrected for as at present. Atmospheric curves have been made for angles of departure up to 20 degrees. They should also be made for angles of departure as high as 65 degrees and correction for atmospheric density made in mortar fire.

Correction for drift can be made as is done at present and no further discussion is necessary.

Other conditions.—In the past correction has been made for tide in gun fire, but not in mortar fire. At few batteries will the average correction for tide exceed 10 yards at medium and long ranges. This is the least reading of the range scales. The advantage to be gained by making an inconsequential correction for tide is almost negligible, but a considerable personnel error may result from the operations of computing and applying the correction. It is therefore held that the correction for tide should be discontinued for all cannon fire. For the same reason it is held that corrections for the rotation and curvature of the earth need not be considered.

Adjustment of Fire

In adjustment of fire correction should be made for those conditions and elements which cannot be measured and the effect of which cannot be computed or corrected before firing. These conditions or elements result in deviations, and adjustment corrections should therefore be based on the deviations. The conditions and elements which cause deviations are armament errors, personnel errors and wind.

Armament Errors are the accidental errors due to the armament itself and include not only errors due to the non-uniform functioning of the gun and carriage, but also such indeterminate errors as those caused by slight differences in the weight and shape of projectiles, slight variations in the weights of charges and slight variation in the density of loading. Armament errors are accidental, follow the laws of probability, are indeterminate and cannot be corrected for.

Personnel Errors are the errors made by individuals in computing and setting the firing data. After the firing is over and all the records are at hand, a proper analysis will show what these personnel errors were, but during the firing they are not known. The ordinary personnel errors of 10, or 20, or 30 yards, made by operators in the inaccurate or hurried setting or reading of an instrument or scale, are in the nature of accidental errors, their algebraic sum for each shot may be compensating or accumulative, positive or negative. The probability of a large error occurring is less than the probability of a small error occurring. Occasionally an unusually large personnel error is made. This might well be considered an abnormal personnel error just as some shots are said to have an abnormal armament error. Occasionally also, when a wrong scale or incorrect reference number is used, a considerable personnel error may be continued through a number of shots. A part or all of such a continuing personnel error may be corrected for by the adjustment

correction, but in this case if the error is removed after it has continued for a few shots due to a new and correct setting, the adjustment will again be thrown off. Therefore all personnel errors, whether normal, abnormal, or continuing, are unknown and indeterminate during firing, are in the nature of accidental errors and may be grouped, insofar as adjustment of fire is concerned, with the accidental errors of armament. These errors may be reduced by care of armament and by training, but when firing once starts they are indeterminate and cannot be corrected for in adjustment of fire. The accidental errors of armament and personnel cause each shot to deviate from the center of impact of the series of shots. In this discussion we are not concerned with these errors because the problem in adjustment of fire is to put the center of impact on the target and keep it there. The remainder of the deviation—that is, the deviation of the center of impact from the target—is due to wind.

Wind.—In the past the surface wind only was measured and corrected for and the correction was applied in preparation of fire. It is well known that there are different air currents or winds at different heights and a projectile in its flight may pass through several of these winds of unknown strength and direction. Even surface winds may vary in the same vicinity due to the configuration of the ground. A surface wind may be entirely offset by an upper wind, their resultant effect being zero. To apply a correction for the surface wind might result in a greater deviation than had no correction been applied.

During the last few years Coast Artillery authorities have been engaged in an attempt to compute a correction for the ballistic wind and apply this correction in the preparation of fire. No discussion of the ballistic wind will be included in this article and no comparison will be made of the advantages and disadvantages of correcting for the ballistic wind in preparation of fire, with the method of applying a wind correction in adjustment of fire as proposed in this article.

Insofar as adjustment of fire is concerned, each of the winds existing in the surface or upper atmosphere may be considered as a force of certain direction and intensity. Each air current does not move with uniform intensity throughout the stratum of air which it occupies, but each has a plane of highest intensity and there is a gradual change from one current to the next throughout the distance between the two planes of highest intensity. When in addition to this it is considered that each instant the projectile is changing its position and that therefore there is a change in the shape and area of its surface on which each of the forces act, it is not difficult to conceive of the projectile being acted on by an almost infinite num-

ber of different wind forces during even a short time of flight. However, we not not be concerned with each of these separate forces provided we can measure the effect of the rsultant force. It is held that the amount of the deviation is a measure of the resultant of all the wind forces which have affected the projectile. It is true that the deviation of any one shot is due to armament errors and personnel errors as well as to wind. These errors are accidental and cannot be eliminated in preparation of fire, but they are eliminated to a great extent during adjustment of fire if adjustment corrections are based on the center of impact.

The following method is proposed for adjustment of fire by a wind correction:

Determine, by any approved method of observation of fire, the range and deflection deviations. Compute, from the deviations, the amount of the flat correction to be applied, using any of the approved methods, such as the center of impact of trial shots, the method of successive approximations, or the salvo center of impact method. Apply the flat range correction on the wind curve chart at the corrected range on which the shot was fired and read from the chart the wind reference number indicated by the correction. Apply the deflection or azimuth correction on a set of wind deflection curves, somewhat similar to the wind range curves, and read from the chart the wind reference number indicated by the chart. Apply these two reference numbers on the wind component indicator, setting the pointer at their intersection and setting the azimuth circle at the corrected azimuth at which the shot was fired. The wind component indicator as now set, gives the range and deflection components for the range and azimuth at which the last shot was fired, and had these components been used, they would have effected a correction equal and opposite to the deviation that actually occurred and there would have been no deviation. Now set the wind component indicator to the azimuth of the setforward point at which the next shot is to be fired and read from it the new range and deflection components of the wind. This corrects for the change in the wind effect due to the change in the direction of fire. Set these components on the range and deflection boards and make the necessary corrections at the range of the setforward point at which the next shot is to be fired. This corrects on the proper wind curves for the change in the effect of the wind due to the change in range of the target.

By this method of applying the correction there is added to the flat correction a variable which compensates for the variation in the wind effect due to the change in both the direction and range of the target, and this variable correction varies according to the same law as does the force (wind) which causes the deviation. When the center of impact is put on the target, this variable correction will keep it there. Although this method is a radical departure from methods heretofore used, nevertheless the search for the proper wind components during adjustment will be confined to limits differing very little from the limits of the flat corrections themselves.

No effort has ever been made to apply a correction in mortar fire for atmospheric conditions, because it was considered impracticable to determine the effect of each of the various atmospheric forces through which the mortar projectile passes. By the proposed system we correct for the effect of atmospheric density in the preparation of fire and apply a correction for the resultant wind effect in adjustment of fire. For mortar fire a different set of curves will be required for each zone, because the effect of retardation and wind force depends on the time of flight and trajectory of the projectile, for the same elevation these are different for each zone in mortar fire. There is a considerable change in the maximum ordinate of trajectories for different elevations within the same zone and it is admitted that the assumption of a constant resultant wind is not exactly correct for mortar fire. However, it is held that the difference in the maximum ordinates within a zone is small compared to the total length of the maximum ordinate at either limit of the zone, and unless a new wind force of considerable intensity be introduced in the stratum between the maximum ordinates, the change in the resultant wind force will be comparatively small and the assumption of a constant resultant is approximately correct and close enough for practical use in adjustment of fire.

We may go one step further with the proposed system as applied to mortar fire. The amount of deviation caused by the wind depends principally on the length of time during which it acts—that is, the time of flight of the projectile—and this time depends on the elevation and zone in mortar fire. Each wind curve represents the effect of a certain definite force on projectiles fired at various elevations. For example, the curve whose reference number is 30 on the wind chart for Zone 6, gives the effect of a certain definite force on projectiles fired at all elevations from 45 to 65 degrees in Zone 6. The curve marked 30 on the wind chart for Zone 7 gives the effect of that same force on projectiles fired at elevations from 45 to 65 degrees in Zone 7. If, by the proposed system in adjustment of fire in Zone 6, we have determined that the force whose reference number is 30 is the resultant force of the existing winds, and the target goes into Zone 7, we can maintain at least approximate adjustment by correcting on curve 30 in the new zone. We therefore have in the proposed system an approximate solution of the problem which has for many years worried battery commanders of mortar batteries, that is, the correction to apply in passing from one zone to another.

It is not claimed that this is an exact solution, because it is admitted that the resultant force may not be exactly the same in both zones. New winds may be introduced in the stratum of air

between the lower limit of one zone and the upper limit of the adjacent zone or, even if no new forces are introduced, if the resultant force is made up of several different forces each of these will act for a slightly different length of time and in a slightly different way on projectiles fired in the new zone. It is, however, unless unusual atmospheric conditions exist, a solution that is approximately correct and is based on a sound principle, that is, applying a correction for the deviation on curves which vary according to the same law as that of the force which causes the deviation.

To return now to the basic problem of preparation and adjustment of fire. It is held that the systems in use are unsatisfactory. These systems differ for each type of armament, they involve principles which are not thoroughly sound and they make use of complicated instruments and boards resulting in frequent and occasionally large personnel errors. The Pratt Range Correction Board, for example, is complicated, cumbersome and costly and, in the past, it has given personnel errors of from 10 to 1000 yards on almost every shot fired at target practices in which it has been used. It is held that radical changes should be made in the interests of simplicity, economy, accuracy and uniformity for all types of cannon.

The following changes are advocated:

1. That until the problem of measuring and correcting for the ballistic wind be solved by a method which will be accurate and practical of application under all conditions, the correction for wind be discontinued in the preparation of fire and be confined solely to correction in adjustment of fire.

2. That adjustment corrections be applied through the wind component indicator and wind curves in order that the adjustment correction will vary for changes in range and direction of fire as the force which causes the deviation varies.

3. That the operations of determining and applying the wind correction be kept independent of the operations of computing and applying the other corrections.

4. That what is now known as Case III be considered the normal, basic method of fire for all cannon.

5. That the procedure in the plotting room consist of four major operations: First, to determine the true range and azimuth of the point to be fired at; second, to determine the corrections in preparation of fire; third, to determine the adjustment corrections, and fourth, to combine the results of the first three operations and determine the firing data.

6. That the Pratt Range Correction Board be replaced by a simple range correction board which will give the range correction

for muzzle velocity and atmosphere only; a plain board having mounted on it a chart containing a set of muzzle velocity curves and a set of atmosphere curves, the sides of the chart graduated in ranges, and with a horizontal ruler guided in its vertical movement along the range scales by T square ends, the ruler containing a simple slide rule device for adding the corrections for velocity and atmosphere.

7. That correction be made for muzzle velocity and atmosphere in mortar and howitzer fire on a similar board, the sets of curves on the chart being divided into zones.

8. That the gun and mortar deflection boards be replaced by a simple azimuth correction board, having mounted on it a chart or table giving, in degrees and hundredths, the drift for any range, or elevation and zone, for the type of cannon being used.

9. That correction for tide be discontinued.

10. That correction on the muzzle velocity curves based on deviations be discontinued.

11. That the use of all meteorological equipment for measuring surface wind be discontinued, and that each battery be equipped with a thermometer and barometer for determining the atmospheric density.

12. That the system for solving the problem of preparation and adjustment of fire be made uniform for all types of cannon, and applicable to different variations of the basic problem simply by the omission of some of the operations.

13. That in the analysis of practice the true armament errors and armament probable error be determined by plotting the "deviations that would have occurred had there been no personnel errors and no adjustment corrections," and eliminating the part of such deviations as was clearly due to the effect of wind.

14. That a "Central Powder Desk" be established at which a study of target practice and other firing records be made and from which there be issued to the service bulletins giving the correct weight of charge to give the normal velocity and the correct muzzle velocity for the normal weight of charge for each lot of powder in use.

The Petroleum Industry and its Influence on the Role of Coast Artillery

By Lieut. Colonel James Prentice, C. A. C.

The oil fields of Roumania, as far as this World War is concerned, are not to be depended upon. They were too thoroughly devastated before being abandoned. What hope, then, is there for victory? It lies alone in securing a new source of liquid fuel. There is still the retort of low temperature for coal, or there is the liquefaction (hydrogenation) of lignite. Better, however, would it be to dry up the river of oil on which the Allies' barge is floating to victory.

It is doubtful that the Allies comprehend the importance of their concentrations of liquid energy. We must strike before they see that we can do so. To destroy the plants at ________ and ________ will be to tie up their greatest regions of production and embarkation. Your missions are to accomplish those results and those alone. Indulge in no nerve shock raids (fearfulness), let blood and return if you can. It is the success of your work alone that can give us sure respite.

THE writer leaves the source of such a piece of literature to the imagination of the readers. There was much crude propaganda literature scattered about during the World War. There were stories of synthetic rubber, synthetic gasoline, the hydrogenation of fats. Most of this we took as the ravings of a defeated and demoralized propaganda bureau.

But what would any of you have thought if he had seen on the same day an item like the above and a report to the effect that a rigid airship had flown from Bulgaria to a point south of Khartoum in Africa and had returned successfully to its home hangar and at the same time you had enough knowledge of the airship to know that this was entirely within the realm of possibility. The writer recognized much of possibility in the above. The hydrogenation of fats was accomplished in 1913. The low temperature still for coal is a commercial fact. Recently lignite has been liquefied. But the term "blood letting"? Could we not properly call Petroleum the life blood of modern industry?

Is it money alone that can be called the sinews of war? Have not new world conditions brought a new significance to the phrase? Can we of the Coast Artillery Corps, in view of the facts later disclosed longer ignore that a new responsibility has been thrust upon us? Can we not see that "the most pressing economic rivalry between nations today is undoubtedly competition for oil, which is more

and more coming to be the vital factor in modern progress. The search for petroleum is world wide, the pursuit is international, and the need common to all mankind."

Money was in the past the sinews of war because it was the symbol of stored up energy and materiel. But, "while man has been coining gold pieces to represent the expended energy of the past, nature has been storing in the depths of the earth liquid energy itself, oil. Today the very essence of power of the destroyer and battleship, plunging mightily through green, tremendous seas, is oil. Without this the navies of the world would become aimless masses of floating steel—lifeless for lack of the sluggish brown liquid that is rapidly coming to control the destinies of great nations."

A great industry, born in the years of travail of our Civil War, has grown up in this country. It has grown up like an orphan child in the house of those who hated it. It was conceived and built up by an heroic and far-visioned few. The bones of some of our greatest adventurers and individualists mark the trail of the oil seeker, not only in our own wildernesses, but all over the world.

The army alone cannot claim that it has stood unlimited injustice and abuse without complaint. The oil fraternity in its short life has built up traditions of adventure and perseverance in the face of death, ingratitude and overwhelming odds that rival our best. What has been their achievement?

Let us contemplate the manner in which petroleum has interpenetrated the entire fabric of modern civilization, its uses on sea and land, and even in clouds; its functions as a creative force in countless industries; the servant of the soldier in time of war, the toiler in time of peace, the ministrant of pleasure, the source of prosperity for entire communities. It has created new industries greater than any that existed before its advent.

Imagine, if you can, what would happen now, in this day of motorized transport, of gas engine driven dynamos, and of industry irrevocably committed to mineral lubricants, if some act of war or a cataclysm of nature should suddenly deprive us of our stores of petroleum and its derivatives and at the same time demoralize our means of transport, storage and refining of the crude product.

We cannot ignore the fact that one-fourth of the world's shipping is now oil driven. That three-fourths of the American merchant marine is oil burning, that practically all the small harbor craft are equipped with gasoline engines. Our harbors would immediately be cluttered with dead shipping and the teeming waterlife that now characterizes our seaboard communities would cease to be. There would be silent factories with sullen industrial masses adding

to the confusion when the deliveries of food, now so dependent on motor vehicles, ceased to be forthcoming. The thirteen million motor vehicles that are the basis of a reborn civilization in the suburbs of our towns and cities would cease to render service and would become a liability. The local stocks in the distributing stations would hardly last a day. In the farming communities there would be idle tractors. There would be the distressed lowing of unwatered and unmilked cattle, for the gasoline engine has replaced the windmill and many dairies now use automatic milkers. The rural and suburban mail service would become inefficient. On the railroads there would be many immobilized locomotives. There would be poor lubrication with resulting burnt out bearings. The sidings would soon be filled with unlubricated cars and all too soon the branch lines and even the main lines would be used for storage purposes.

We should not forget what happened to the railroad service of Germany when her stocks of lubricants failed her and she found that she had won a barren victory in Roumania with her devastated oil fields.

Can you imagine an attempt to mobilize a modern army without an unlimited supply of petroleum derivatives? We would even be unable to rush antiaircraft guns to the defense of the tank farms and refineries that now clutter the environments of our great harbors. Our heavy artillery weapons would become veritable white elephants. The few pitiful teams we could mobilize to haul rations and the sick and wounded would soon be ruined by inexperienced drivers, or they would starve for lack of the hay and grain that is no longer distributed along the routes of travel as it was in the old days of animal drawn transport.

If it were war, the councils of the nation would surely be confounded. It is safe to predict that many coastal cities would soon be put under tribute and the airborne forces of an enemy who could conceive and carry out such a stroke would soon penetrate inland for further conquest and above all cut the lines of transport for oil to replace the lost reserves.

One of our greatest dreads has always been that some ships will run into the harbor of New York and bombard the financial district. Wall Street was bombarded once in a small way by anarchists. We know that the psychological effect is something terrific. It might be likened to a knockout blow on the jaw. The real military damage would be small. There would be a come-back. But to destroy a great oil storage and distilling area like Bayonne would be like cutting the jugular vein. If the lesion were not closed immediately the

very blood of life would flow out of the veins of a great industrial region. There would be no comeback. There would be death.

The question might be asked, what influence can the petroleum industry have on the *role of Coast Artillery.* It is a relation that is easy to understand if one will study the petroleum industry even in the most cursory manner. It is hardly proper to publish here the storage and refinery data of this country. To begin with it would be a formidable array of charts and tabulations. It would also reveal a national state of unpreparedness which the Germans undoubtedly noted when they planned a greater mission for some airships after the revelation of the now substantiated trip to Khartoum.

There was an ancient philosopher whose teachings are now the faith of over four hundred million Asiatics, who once said: "He who has looked upon the ocean can think of no other waters." This is true of great industries as well as with individuals. The oil industry has looked upon the ocean a great deal lately. It has picked out the water route as its backbone of transport. They have built up in or near a few of our harbors their greatest storage plants and refineries. These vulnerable plants could nearly all be destroyed by the reverse fire of armament now installed but poorly guarded. I doubt that the average army officer knows where most of our reserve stocks are stored or where refined or where distributed from.

I know from visits, some recent, to several harbors that a vital point is being missed. Our greatest and most vital oil accumulations are open to attacks from the air and from the sea. I contend that the Coast Artillery can no longer ignore these facts nor afford to delay in concentrating some of its best thought on the subject. Especially those officers who are charged with the antiaircraft work.

Let us visualize the oil industry and at the same time point out a beginning of the means of defense. I quote the words of a man high in the councils of the oil world, "There are about 300,000 oil wells scattered from Pennsylvania to California and from Montana to the Gulf. These are owned by about 15,000 different corporations, partnerships and individuals, 250,000 of these wells are small producers, averaging only a few barrels a day (2 to 5), the remainder is supplied by a few thousand gushers in new fields or is brought in from abroad. There are 60,000 miles of main trunk pipe lines and tens of thousands of gathering lines with hundreds of pumping stations. There are scores of tank farms holding millions of barrels of crude oil. There are over 500 refineries in addition to thousands of marketing stations. Much of our oil comes from abroad, especially from Mexico. There are fleets of tankers with docking and loading facilities in most of our harbors."

The fact that I wish to lay emphasis on is that all too large a share of our stocks, refineries and distributing facilities are located close to the harbors of San Francisco, Los Angeles, Galveston, Port Arthur, New Orleans, Gulfport, Pensacola, Savannah, Charleston, Norfolk, Baltimore, Philadelphia (Marcus Hook), New York (Bayonne), Providence, Fall River and Boston. Our entire export and import trade is based on these points. This matter has caused much apprehension in naval circles, but I have heard of no protest from army circles. I believe that such protests would be futile anyhow. The oilman like any other business man is inclined to ignore the matter of protection in time of war and concentrate his thought and capital in getting up production and distribution facilities that are best located from the commercial point of view. Their point of view is best expressed in the following words: "The necessity of locating oil refineries where they can be within reasonable reach of crude oil supplies and the markets is a generally recognized business fact. It is coming to be more generally realized that Mid-continental refineries are handicapped in competition with coastal refineries because of the discrepancy between freight rates charged by the pipe line companies and railroads and ocean carriers. The coastal refiner is gradually getting more and more of the business in his territory, which is the richest, besides having an advantage in supplying export requirements. Witness the growth of the Standard Oil Co. of New York, The Standard Oil Co. of New Jersey, The Gulf Oil Corporation, The Texas Co., and many other companies similarly located.

Refineries located in the heart of the large oil fields are not necessarily well located. Fields close to the seaports where oil can be shipped by water provide good locations for refineries, witness California and the Gulf Coast areas."

Most of the great trunk pipe lines lead into very few harbors. They flow constant streams into these limited but strategical areas. The levels of the huge tanks rise and fall with the tides of supply and demand. These streams must never be stopped flowing. Once out of the ground the oil is generally hastened in the crude form to the regions of its consumption. The life of a new field is generally transitory. There are great risks involved in new fields. There are losses by fire, by evaporation, by soakage in improvised earthen dams, by leakage and by theft and litigation. Very little tankage is built close to the wells. The producers hasten to get their oil out of the ground before some other producers offset their holes, and nearly all turn their product over to the various pipe line companies, subsidiary to the great refining and merchandizing firms, whose agents

and pipe laying crews show up almost over night after a discovery in a new field. These collection lines trend toward the great central trunk lines that stretch from the Rockies to the Atlantic near New York and Philadelphia on the east; to Port Arthur, Galveston and Baton Rouge on the Gulf; and to San Francisco and San Pedro in California.

In the harbors of California and the Gulf there are great loading racks, all open to sea or air attack, where the tankers take on the cargoes that are more and more being segregated in the North Atlantic ports. This stream of oil from the three new gusher fields near Los Angeles in a measure accounts for the unexpected income of the Panama Canal.

We should not get into the idea that much of our oil is transported by rail. There are not enough tank cars in the world to handle even a fourth of the oil. I believe only 10 percent of the barrel mileage can be charged to this means. Crude goes by pipe line to large refining centers. Thence by short rail and motor car haul the finished products are put on the market. Except near these great centers the fuel for local consumption is on a hand-to-mouth basis. There is where the danger lies. Before winter sets in all the oil is moved that can be bought and stored. Pipe lines do not run well in winter. There is generally a three months reserve in the great harbors and a few places inland such as Kansas City, Chicago, Cleveland and Buffalo.

The margin between supply and demand can be easily determined by watching the refinery stocks and a few of the producers tank farms. If we were to lose a storage farm and refinery project like that at Bayonne or if the refineries and distributing facilities near it were to be disturbed and disorganized, even for a day, there would be worry among millions of consumers, prices would fluctuate rapidly over the entire seaboard and whole industries would be distressed.

The oil industry is now one of the big three. Over eight billion dollars capital have been invested in it. It is growing rapidly still. But its great and most vulnerable concentrations of value are coastal stocks and refineries with their facilities for distribution. Here, too, are stored those priceless stocks of lubricants and special derivatives that enter into so many activities of our modern life.

It is these coastal establishments that are bound to be the initial points of attack in a modern war. It is here that the greatest military damage can be done in the least time. To burn up the three months supply that is generally kept near a great city is to cripple that community, especially if the tanks are warped and the refineries

crippled. These coastal refineries are vast projects, complicated to a wonderful degree.

Having crippled the reserve and the refineries near it what would an air force do? They would proceed inland tracing the pipe lines and bombing the pumping stations that are spaced at intervals of from five to thirty miles, depending on grade. The great throbbing brown streams would soon cease to flow. The lakes of wasted oil in the mountain valleys would be ignited and ominous black clouds would show the path of destruction and our embarrassment. Our chances of quick mobilization would go like snow in late spring. We could hardly hope to match an enemy who had seized or destroyed our coastal stocks and had cut off the arterial system of supply. He would have the whole sea and all the world to draw on. We would have only meagre facilities by rail from the depleted fields of the Mid-Continental producing area.

How then can we ward off such attacks? The first thing to do is to get so many wires aloft over the storage and refinery areas that the airman's bombing must be conducted from high altitudes. At about the same time antiaircraft batteries should be established at advantageous points to surround them. Liaison with the air forces must be established. These establishments can hardly be included in the aerial defenses of the adjoining cities. They are too remote. These will be initial points of attack. They will be attacks by small fast planes. These are easily damaged by wires as was proven by the balloonists in the defenses of Paris.

Now as to the means of raising wires. It can be done on windy days by means of box kites in series, that is, one every thousand feet of wire. By this expedient the weather bureau has sent up 40,000 feet of wire at Drexel. On calm days there is the barage balloon, a small-sized stream lined affair somewhat similar to the observation balloon without a basket. There is also the small free balloon made of cheapest cheese cloth dipped in solution. These will go up like a shot, trailing after them thousands of feet of specially coiled wire that unreels as they ascend. These will drift all over the community and are like the deep sea mine, but unfortunately they soon sink. There is also the rocket for quick work as well as a special bomb in which are stored length of wire with small parachutes at frequent intervals. The explosive charges are very small and the fuse simple. Wire when attached to miniature parachutes falls at the rate of about 500 feet per minute. In other words if a wire bomb opens at 5000 feet it will take it ten minutes to fall to earth. If it catches an up draft it may even ascend and remain aloft for over fifteen minutes.

The aviator hates wire. His craft is a fragile thing. A piece of wire in a propeller is certain to raise havoc with controls, damage engine mechanisms, rip fabric, even aluminum, demoralize the operator and generally dampen the ardor of an attack on an area that is properly prepared.

There is too much tendency nowadays to concede it all to the Air Service. They have never had an opportunity to attack a wire-webbed volume of air. They should not think that any navy or coast defense will say it is fate when they hear the whir of propellers overhead. Aircraft must pass over or close to the zenith of its objective. An objective as small as an oil refinery or a tank farm is easy to defend if we will only think it out in advance and be prepared.

Before it is too late and the facilities near some of these oil centers I have mentioned have been sold out or eliminated we should establish thereat storage facilities for the defenses of the adjoining tank farms and refineries. At least a battery of antiaircraft personnel should be constantly kept at Fort Howard to defend the Baltimore plants, one at Wadsworth to help Bayonne, one at New Bedford to help Fall River, one at some Boston post to operate in that harbor. One at Fort Story or Fort Monroe to defend the Tidewater reserves, one at Charleston, one at Pensacola, and others at Galveston, New Orleans and Port Arthur. On the Pacific Coast there should be one at San Pedro and another at San Francisco. These would serve as nuclei for the training of reserves in fast preparation.

Fire Control System for 155-mm. Guns

EDITOR'S NOTE: *The following article was recently prepared by the Coast Artillery Board as Project No. 75 and submitted to the Chief of Coast Artillery for his consideration. The recommendations appearing at the end of this article were approved by the Chief of Coast Artillery subject to reconsideration by the Board of the relative merits of the Pratt Range Board and of the Range Correction Computors of the type described under Coast Artillery Board Notes as Project No. 174, in the December, 1923 issue of* THE COAST ARTILLERY JOURNAL. *Although this article will eventually appear as a Training Regulation, it is believed its publication at this time will meet with the approval of all those in any way connected with tractor artillery instruction.*

HISTORY OF THE PROJECT

THE project was originated by the Coast Artillery Board and is a study of the fire control system necessary to adapt the 155-mm. guns to fire on naval targets.

The basis for this study is contained in War Plans Division Document No. 1, "A Positive System of Coast Defense," and paragraph 15, T. R. No. 10-5, "Doctrines, Principles and Methods, Basic." The necessity for the study has been emphasized by consideration of Chapter XXVII, Defense of a Coast Line, Vol. IV, "Tactical Principles and Decisions," General Service Schools, 1922, which discusses the defense of unfortified harbor of Monterey. Neither the problem nor the solution given therein utilizes mobile Coast Artillery units, as contemplated in approved War Department Doctrine. The fallacy in the General Service School problem and solution is discussed on pages 57-59 of THE COAST ARTILLERY JOURNAL for July, 1923. It is believed that Coast Defense operations will involve many situations typified by Monterey Harbor, and that the basis for the defense of such localities must be mobile seacoast artillery which includes the 155-mm. gun organizations equipped and the personnel trained for delivery of effective fire on naval targets.

CONSIDERATION OF THE REQUIREMENTS

1. A fire control system for 155-mm. guns assigned to the Coast Artillery should be adaptable to the following missions:

a. Harbor defense, in which guns may be operated from selected positions within the boundaries of a fort, and may use the standard, or emergency, position finding system and communications of the forts, or may establish a separate position finding system. This mission is practically the same as that of the 6-inch seacoast guns and includes the defense of mine fields, submarine nets, and other defensive channel obstructions and demolition fire upon suitable targets. Suitable targets are unarmored and lightly armored ships, the personnel, communications, upper works and control centers of major vessels.

b. Coast defense in which the guns may be operated in areas contiguous to Coast Artillery forts. They may be used to cover contact mine fields located in defensive sea areas, or to frustrate landings in enemy flanking operations against coast defense strong points, in addition to such assignments as are given in subparagraph *a* above. Under these conditions the organizations will require a position finding system and communications therefor which are independent of, but may be interconnected with those of the nearby forts.

c. Coast defense in which the guns may be used to defend small coastal cities against harassing attacks by enemy cruisers or submarines. This contemplates their use in accordance with the provisions of W. P. D. Document No. 1, Joint Army and Navy Board on Seacoast Defense. Usually this mission should include the defense of small harbors possessing facilities at which heavy transport may be landed, and the defense of suitable beaches for landing troops. Under such conditions the guns will require position finding equipment and communications suitable for fire on targets capable of maneuvering at high speed.

d. Landward defense of seacoast fortifications.

e. Land operations with field armies when tractor artillery can be used against targets suitable for the power of this class of artillery.

2. An important peace time use for these cannon is as a means for training Coast Artillery National Guard and R. O. T. C. units, many of which are at points remote from the seaboard, in the technique of Coast Artillery fire on naval targets. Reference is had to the report on Coast Artillery Board Project No. 116, "Fire Control Systems for National Guard."

3. *a*. The missions indicated above are well within the capabilities of this gun, which has a split trail carriage, 60 degrees traverse without moving trail, and a maximum attainable rate of aimed fire of four to six shots per minute and a maximum range of 17,000 and 25,000 yards. The fire control equipment supplied to the organizations therefore should be suitable for fire upon both land and water targets.

b. It should be noted that the slow rate of fire, one and one-half shots per minute, credited to this armament as a result of its usage in France, does not take into consideration the maximum attainable rate which may be had in seacoast actions, as conclusively demonstrated at Fort Eustis.

4. The fire control system, methods and materiel, required for fire on land targets are known sufficiently well to call for little or no comment herein as to what this system should be. It is ill adapted to fire on naval targets and it is chiefly to a consideration of the methods and materiel best suited to this gun for fire on naval targets that this report is devoted. The system which will be recommended

must be suitable to the dual role of firing on land and water targets, but it may be stated as axiomatic, in view of our wartime experience, that any mobile Coast Artillery organization which is equipped and trained to fire effectively at fast moving naval targets can be depended upon for effective fire at any suitable target which may be encountered in land warfare. The converse does not follow.

5. Observing instruments (Model 1918 azimuth instruments) are essential equipment for these guns when employed in any of the above missions. The instruments and communications necessary to connect the various observation posts to the command posts of the battery and battalion when firing upon fixed targets, become the observing stations and communications of a horizontal base position finding system when firing upon moving targets. Regardless of the system which may be adopted for these guns for fire on moving targets, the inclusion in tables of allowances of some of the essential equipment for horizontal base position finding for such fire has been dictated already by land warfare requirements.

6. *a.* In seacoast warfare, it is essential that a fire control system for fire on naval targets be available as soon as the guns are in position, and that the system be capable of furnishing accurate firing data to the guns as soon as a suitable target enters the field of fire.

b. The expected ranges should be considered. It is customary to consider the 6-inch and 155-mm. guns as short range weapons, that is, for use at ranges of about 5000 yards, but it is just as logical to consider using these cannon at their maximum ranges upon suitable targets, as it is to consider using major caliber armament at extreme ranges upon battleships. It is probable that suitable targets for 155-mm. guns will be employed to lay smoke screens to shoreward of battleships at ranges between 10,000 and 20,000 yards. It is certainly sound tactics when combating with these guns such a raid as was made by German ships on Scarborough and Hartlepoole, to inflict as much damage as possible before raiders can close to their own most effective range.

c. The battleship is a more powerful and consequently more important target for artillery fire than those targets normally suitable for attack by 155-mm. guns. Nevertheless, accuracy in position finding is equally essential for the 155-mm. gun as for major caliber armament when the size, speed and maneuvering ability of the respective targets is considered. Accuracy per round is desirable for 6-inch as well as for 12-inch and the usual claim that the more rapid rate of fire for the 6-inch establishes a parity in accuracy by a parity in the number of probable hits per gun per minute is unsound. The goal of an artilleryman must be the maximum of hits per gun per period—the period that a naval target is exposed to his fire.

7. *a.* A portable range finder cannot furnish fundamental firing data with the accuracy essential to destructive fire upon a fast moving target at the ranges which must be considered. The Coast Artillery Board knows of no portable range finder which can measure ranges beyond 6000 yards with sufficient accuracy for normal use. Even though a range finder which will meet the requirement as to accuracy may be developed eventually, it is probable that its weight, size, cost and lack of portability will preclude its adoption for tractor artillery units.

b. Unquestionably a range finder is a valuable supplement to the position finding system of any battery, fixed or mobile, but its use would be confined to such emergencies as the breakdown of a normal system based upon a long horizontal base and plotting board, and for the unusual contingencies which may require immediate fire before a horizontal base system can be established.

8. *a.* Attention is invited to Artillery Bulletin No. 89 (Serial No. 117) April 9, 1914. This bulletin prescribes a horizontal base position finding system for 5-inch and 6-inch batteries. The Coast Artillery Board agrees with this bulletin as being sound doctrine and believes that the increased ranges of present fixed and mobile seacoast guns of similar caliber, demand the equipment prescribed therein.

b. Instead of a horizontal base position finding system and plotting board for these guns, some officers prefer a range finder as a standard basis for position finding and cite the very good shooting of the intermediate armament of American battleships as establishing the sufficiency of the range finder. They apparently lose sight of the fact that the Navy is doing good shooting in spite of their imperfect position finding system. The advantages of guns ashore over guns afloat are due principally to the comparative invulnerability of the guns ashore, and to the inherently better position finding system—a long horizontal base—which usually can be made available for use by shore guns. In choosing a position finding system for shore guns whose mission is to combat guns afloat none of the advantages in position finding which accrue to the shore guns should be sacrificed if it be practicable to retain these advantages. These advantages can be retained by providing a horizontal base system which includes a plotting board. The guns will be equipped best for fulfillment of the missions described by having the materiel adaptable to both systems included in tables of allowances. It should be noted that much of the equipment required for a horizontal base system also is required when the range finder is used. Since the land warfare equipment now in the hands of 155-mm gun organizations includes neither a range finder nor a plotting board, it is evident that such land warfare equipment is inadequate for firing on naval targets. Therefore, additional equipment suitable for firing

on naval targets must be provided and cannot be classified as unnecessary impedimenta in the case of mobile Coast Artillery.

9. While a horizontal base position finding system including a plotting board, with a range finder for emergency use should be basic equipment for these guns because of the missions of the armament, it should be noted that other advantages accrue to such a selection. The fire control methods and materiel would parallel closely those used by fixed and railway artillery in coast defense. This would result in a common doctrine for seacoast artillery, fixed and mobile. The advantage of this simplicity and lessening of training difficulties in a wartime expansion is considerable. The interchangeability of standard fire control materiel should make practicable considerable economies in both peacetime and wartime production, because materiel at obsolete fixed batteries can be converted to the needs of mobile artillery in time of peace, and because in time of war, supply or replenishment, of some equipment needed in an active theater can be made from far distant and inactive fixed batteries which can better afford to await arsenal or civilian production.

10. *a.* It is believed that in general a horizontal base system capable of furnishing accurate firing data can be established without serious delay. There appears to be considerable apprehension as to the feasibility of establishing readily a horizontal base system following quick changes in battery positions. It is upon a misapprehension of the facility with which a suitable system may be established that the opposition to long horizontal base materiel and the preference for a range finder as basic equipment rests.

b. It may be expected that orders requiring an artillery organization to occupy positions in a certain coastal area will be issued sufficiently in advance of the time specified for the occupation to permit of the reconnaissance and surveys necessary to establish a horizontal base position finding system. Allowing a reasonable minimum of time between receipt of orders to change position and the occupation of the new position, it should be feasible in general if the battery and battalion details be properly organized, to survey and install a suitable horizontal base system so that accurate firing data can be supplied as soon as the guns can be made ready to fire from the new position.

c. Assume for example that the unit is occupying a position for coastal operations and that a long horizontal base system has been installed. After receipt of orders to occupy a new position the unit commander must withdraw his unit and its equipment from the position it is occupying, must make a reconnaissance of the new position, transport his unit to the new position, and emplace it there. The reconnaissance of the new position should be in progress before the unit has left the old position. The withdrawal of the unit from the old position, its transportation to the new position and subse-

quent emplacement, no matter how well trained the organization may be, are procedures requiring not a little time to complete. It may be expected as a general condition that battery or battalion details well trained in orientation work can be transported quickly from the old to the new position with all the surveying and communications equipment necessary to rapid prosecution of the work of establishing a long horizontal base system.

d. By referring to the report on Coast Artillery Board Project No. 131, "Panoramic Sights for Mobile Artillery," it will be noted that it is anticipated therein that this class of artillery when employed in coastal operations usually will be emplaced for the use of direct fire. Surveys under these conditions should be accomplished easily. The beach in front of the battery position, or the headlands when no beach exists, may be utilized and there should be the minimum of interference to a survey caused by intervening trees or underbrush. Chaining along a beach is a simple matter. In most cases triangulations from shorter base lines may be utilized to obtain the length of the long horizontal base lind with both speed and accuracy.

e. Accurate orientation, while desirable, is not an essential to accurate firing data. The essentials are:

(1) A meander line between base end stations, run while the secondary station is being selected and communications installed. The primary station presumably would be located at or near the positions at which the guns will be emplaced.

(2) A measurement of the base line to an accuracy of about one foot in 2000. As noted in *d* above, shorter triangulations may be resorted to, and in general, distances measured along a beach at sea level easily should come within this requirement as to accuracy.

(3) A measurement of the angles and distances between either base end station, the aiming points, and gunsights. Under the conditions assumed, the labor of cutting away intervening trees and underbrush rarely will be required, and operations (2) and (3) may be accomplished with speed and accuracy.

(4) The azimuth of the base line may be guessed at or an approximate compass bearing used and azimuth instruments, plotting board, and gun sights (in Case III) oriented to conform to this assumed orientation.

(5) Accurate range and direction of fire may be obtained by the preceding provisions. Some time later when accurate orientation data have been obtained the plotting board, azimuth instruments, and gun sights may be re-oriented on true azimuths, if desired. This can be effected quickly and easily, but at some convenient time.

(6) The above provisions meet the general conditions in which selection of positions for guns and base end stations have not been made in time of peace in accordance with the principles announced in "A Positive System of Coast Defense," W. P. D. Document No. 1.

In all locations where the wartime usage of these guns can be foreseen, especially in Panama, Hawaii and Corregidor, a detailed plan for employment should be worked out in advance. Emergency surveys such as described above should not be necessary then, except in very exceptional cases. It is apparent that such detailed plans should be prepared at such places if this has not been done already.

f. Local conditions should be the controlling consideration in fixing the length of base lines. The most suitable base line in the general case is one from two to three miles long. In any case base lines should be long if local conditions permit. In special situations such as exist at Corregidor and possibly at Hawaii and Panama, only comparatively short base lines will be practicable, and they will be satisfactory.

g. The installation of the necessary communications under the conditions of paragraph 10 *a* should not be difficult. Some of the equipment, such as the reels and reel carts prescribed in Section VII, Table IV-G, War Department Circular No. 373, 1920, are very well suited for use by these units in establishing long horizontal bases. In 1923 the Coast Artillery Board conducted some tests at Fort Eustis which demonstrated clearly that field telephone wire laid upon the ground is less liable to rupture by enemy shell fire than wire supported on pole lines or trees. This was reported on in Coast Artillery Board Project No. 3, "Effect of Heavy Artillery Fire on Fire Control Communications," dated June 14, 1923. The best communication lines under the conditions referred to are those laid in the easiest and quickest manner, to-wit, wire laid on the ground from Type RL 16 reel carts. After communications have been installed, additional protection against high explosive shell fragments and the effects of weather conditions may be given. This latter provision does not affect the time in which communications necessary for opening fire may be installed since it is in the nature of an improvement in the installation after the battery position has been occupied.

h. In general, then, communications and a long horizontal base position finding system can be installed and be in operation by the time a unit changing positions can have the guns ready to fire, if a proper organization for making surveys and installing communications exists within the unit.

11. The viewpoint of the Coast Artillery Board as evidenced in the above discussion may be restated thus:

For accomplishment of the primary mission of these units, to-wit, the destruction of naval targets, the fire control system should consist of a long horizontal base position finding system, with a suitable range finder for emergency use.

Fire Control Equipment Suitable for Fire on Naval Targets

12. *a.* A plotting board is required which is adaptable to changes in battery positions, as well as to changes in horizontal base

lines. It is possible that contingencies in which a single base line will have to serve more than one battery will arise, or, as is more probable, conditions of terrain may be encountered in which the guns of a battery may have such dispersion of gun positions that relocation of firing data for more than one directing point may be necessary. Whistler-Hearn and 110-degree plotting boards do not possess sufficient flexibility to meet the above conditions. These conditions may be met satisfactorily, however, by the Cloke Plotting and Relocating Board of the type now under construction at Frankford Arsenal. It should be noted also that the Cloke Board can utilize either degrees and hundredths, or mils, or both, in plotting target positions, and can determine firing azimuths in either or both units.

b. The Universal Platen for Cloke Boards is essential equipment because it meets the conditions of *a* above, better than the fixed platen which will rarely, if ever, be used by this class of artillery.

c. The Cloke Plotting board is simple, and considering its advantages, it is not too expensive. The matter of its weight is not a serious handicap. It is no heavier than is necessary to insure its ability to withstand field conditions. The men who operate it can handle it without difficulty. Because it is flat and hence not bulky it can be transported easily on a truck together with the other necessary equipment.

d. The plotting board may be used as a firing board under land warfare conditions.

e. Complete information concerning the Cloke Board and its adaptability to the uses of tractor artillery may be found in the reports on Coast Artillery Board Projects Nos. 78, 154 and 178. A description of the construction and operation of the board is contained in Training Regulations 435-221, "Fire Control and Position Finding."

13. *a*. The Model 1918 azimuth instruments now allotted to these units for use in land warfare are suitable for use as observing instruments in the base end stations of a long horizontal base position finding system.

b. In certain contingencies, such as the breakdown of a horizontal base system in Case III fire, an azimuth instrument located near the battery position could be utilized to obtain the angular travel of the target, and this, in conjunction with the use of a range finder for obtaining firing ranges would be an acceptable method for meeting such an emergency.

c. In land warfare these instruments would be used at command and observation posts.

14. *a*. A separate study of the communications suitable to this fire control system will be reported on in a later Coast Artillery Board Project. It appears that more telephones than are authorized now in Table IV-G, War Department Circular No. 373, 1920, will be necessary. Probably the 4-line switchboard authorized as

standard for a battery is inadequate and should be displaced by approximately a 12-line switchboard such as is authorized now for a battalion.

b. Under Project No. 56, the Coast Artillery Board reported upon a motor driven time interval apparatus and recommended certain changes in the construction of the device. An improved apparatus is before the Board for test in comparison with a clock driven mechanism. The test should determine which of the devices is the better governor for a time interval signal for mobile artillery. Report on this will be made under Project No. 200.

c. Under Project No. 153, the Coast Artillery Board reported on a time interval system developed in the 55th Artillery, C. A. C. An advantage of this system is the elimination of the separate line required for a bell signal. The principal feature of the system is the introduction of a satisfactory buzzer note at regular intervals in the telephone receivers of a mobile battery which uses a long horizontal base position finding system.

d. Coast Artillery Board Project No. 111 was a consideration of "Fire Control Telephone Systems for Fixed and Mobile Artillery." An exhibit to the report on this project was an article entitled, "What Ails Our Fire Control Telephones," as published by Major Louis B. Bender, Signal Corps, in the July, 1922 issue of THE COAST ARTILLERY JOURNAL. The article advocated the adoption of some form of local battery installation. Experiments conducted at Fort Eustis by mobile units as reported upon in Project No. 111 indicated that a local battery installation would be most desirable. It was recommended in the report mentioned, that the Signal Corps design and submit for test the essential elements of one or more sample fire control systems. On October 29, 1923, the Chief of Coast Artillery referred the report to the Chief Signal Officer and suggested that a conference be called to discuss feasible methods for the improvement of the present communication system. The outcome of this conference has not been made known to the Coast Artillery Board.

e. As evidenced in subparagraphs *a* to *d* above the probable developments in mobile artillery communications will be:

(1) Some form of local battery system.

(2) A time interval system in which a separate bell line is not used but, as a substitute, a buzzer note is induced in the telephone receivers by a motor driven or clock driven mechanism—probably the latter. A howler probably will be used to give signals at the battery positions for salvo fire. This time interval system should be adjustable so as to give:

(a) Three buzzer notes on the thirty-second intervals; one buzzer note ten seconds after the thirty-second interval; two buzzer notes twenty seconds after the thirty-second interval; or

(b) Three buzzer notes on the thirty-second intervals, and one buzzer note on the intermediate fifteen-second intervals.

(3) Communications equipment suitable for a long horizontal base position finding system.

15. It is believed that the use of the current prediction devices, but especially the pantograph predictor as an aid to freehand prediction, are satisfactory means for locating setforward points on the plotting board. Reference is had in this connection to the report on Coast Artillery Board Project No. 93.

16. A range percentage corrector as described in the report on Coast Artillery Board Projects Nos. 152 and 170 would be desirable equipment for applying ballistic and arbitrary corrections to actual ranges, so that the corrections may vary with the determined ranges in a satisfactory manner. The device may be used either with a long horizontal base position finding system, or with a system which includes a range finder. When a plotting board is in operation the device may be used in conjunction with direct prediction on the plotting board or in conjunction with separate prediction on prediction boards. Corrected elevations for normal charge, supercharge, subcaliber, or the range elevation relations necessitated by changes in fuses or type of shell, may be obtained from this device with equal facility. A description of the construction and operation of the corrector is contained in Training Regulations 435-221, "Fire Control and Position Finding."

17. *a.* The Pratt Range Board, Model of 1905, is desirable equipment for these units. By reducing slightly the vertical scale of the chart for these boards and by increasing the size of the chart to the maximum dimensions permissible, complete sets of curves for both normal charge and supercharge may be included in a single chart. The charts should be constructed in general conformity with the report on Coast Artillery Board Projects Nos. 152 and 170. Modification of the correction rulers now standard for Pratt Range Boards, is desirable. A correction ruler modified as were those furnished with Range Correction Board, Model E 1923, would be satisfactory.

b. The range correction computer (sometimes referred to as a circular range corrector) reported upon under Project No. 174, is not sufficiently satisfactory to warrant a recommendation for its adoption for use against naval targets. As compared with the Pratt Range Board it is less accurate, less convenient, offers more chances for personnel errors, and is slower to operate. It is, however, less expensive, but is not inexpensive. It is light and compact—considerable advantages when its use by mobile batteries is considered. The Pratt Range Board is not heavy, is portable, and can be carried easily in the truck which each battery should have for transportation of the fire control equipment.

18. A wind component indicator is required in connection with the range correction board and deflection board.

19. *a.* An experimental model of a deflection board, expected to be suitable for all seacoast batteries, is nearing completion at Frankford Arsenal. When completed the device will be sent to the Coast Artillery Board for test. If the instrument proves satisfactory a recommendation probably will be made for issuance of the device to tractor drawn batteries.

b. It should be noted that under Project No. 131, "Panoramic Sights for Mobile Artillery," the Coast Artillery Board recommended the provision of a direct fire telescope on a mounting to which a modified panoramic sight could be adapted easily for Case III fire. The approval of these recommendations will, in effect, approve also of the principle that 155-mm. gun batteries should be emplaced, whenever practicable, for the employment of direct fire when such units are to be used against naval targets. Assuming that such approval will be made, the provision of a deflection board is not a pressing necessity, because the chief function of such a board is its use in Case III fire. It is evident that provision for Case III fire must be made, but until a suitable deflection board becomes available, tractor units can improvise locally a board which should be satisfactory for direct or indirect fire. For Case I and Case II fire the initial deflection can be computed, or determined on an improvised board, and then applied to the sight, further corrections being made by the gunpointer. If the gunpointer be unable to make such corrections, or if the battery commander prefer to order corrections himself, an azimuth instrument or the spotting instrument set up near the battery may be used to determine the value of the deflection corrections necessary.

20. a. It is unnecessary to take observations from base end stations oftener than every 30 seconds, because it is impracticable to make predictions oftener than every 30 seconds. However, it is necessary to provide a means for subdividing the range and azimuth predictions in order that the rate of accurate fire of these rapid fire units may be the maximum. No thoroughly satisfactory means for subdividing these predictions has been prescribed. For fixed guns the time range relation board has been used for interpolation of firing ranges together with creeping on the range drum of the gun. There is no serious objection to "creeping," but the operations between procurement of a corrected range to the setforward point and the receipt of firing data by the range setters at the guns always have been cumbersome. It has been customary to plot the time range curve on the time range relation board and then interpolate for the intermediate intervals. Usually two men were required and these from the most intelligent personnel in the organization.

b. In the target practices of the 155-mm. gun batteries at Fort Eustis, firing elevations were sent to the guns every 10 seconds.

In Battery "C" of the 51st Artillery, the corrected elevation corresponding to the range determined by the plotter was called to a man using a pad and pencil who recorded this elevation. Thirty seconds later the man using the pad received another corrected elevation. This man obtained by mental arithmetic the difference between the last two elevations, divided the difference into thirds interpolated and extrapolated the corrected firing elevation for each 10-second interval, and called to the elevation setters at the guns, after each bell, the elevation which should be set upon the guns by the next bell. That part of the process which involved mental arithmetic, simple as it was, was replete with small errors. In another battery the operations for interpolating elevations were performed mechanically on a modified range percentage corrector. A series of worms and gears for displacing pointers to an elevation tape were used. The device was complicated, would be very expensive to construct, and had other features which were unsatisfactory.

c. Where Case III fire was employed by the batteries a process of creeping in azimuth was accomplished on a "synchronizer" in the plotting room, so that each mil in azimuth was sent to the sight-setter. The process was satisfactory for the slow speed of target practices, but it would be difficult to call and set each mil of azimuth in the case of a fast target at short range moving normal to the plane of fire and therefore an unsuitable process to use under service conditions.

d. It is believed that the method for interpolation used in Battery "C" can be improved sufficiently to be satisfactory. Exhibit "A" attached is a photographic copy of a *time range spiral.* A complete set of numbers for each 10 yards from 3000 to 20,000 is arranged spirally on the print which is mounted on a small drawing board. A piece of transparent celluloid which will take pencil marks covers the print and both the print and celluloid may be revolved together on the board about a pivot at the center of the print. The device is a substitute for the time range board now used by fixed gun batteries. It accomplishes everything which a time range board accomplishes, is simpler, requires but one operator, is cheap—that is, arsenal construction is not necessary since the prints can be furnished by the Coast Artillery Board—and appears to be a thoroughly satisfactory solution of a problem which, as noted in subparagraph *a*, above, has not been solved satisfactorily before. While the print shown is in ranges, it is apparent that a similar spiral containing each mil or each minute of elevaton, can be made and that for units which lay in elevation by use of degrees and minutes a (sexagesimal) scale of each degree and minute of elevation can be included in another similar device. For Case III fire it is evident that a time azimuth device for each mil or each five one-hundredths of a degree in azimuth can be made. For 155-mm. gun organizations both a time elevation device and time azimuth device

should be provided. These may be included in the tables of equipment at little or no cost. Prints for the devices can be furnished by the Coast Artillery Board, the small drawing boards necessary are already in Table IV-G, Circular 373, War Department, 1920, as firing boards for land firing. The battery commander should obtain locally the transparent celluloid or he may utilize the transparent vellum paper which is provided now under Table IV-G, "Drafting Equipment." Detailed instructions for constructing the device are given at the middle of the print. Detailed suggestions for the operation of the device are given in paragraph 44 below.

21. A provision for observation of fire is very desirable. In general, the same base end stations used for tracking may be used for spotting and when time permits separate lines of communications connecting the spotters with the spotting device operator should be installed. When conditions are such that the spotters lines cannot be established before opening fire then the results of spotting may be sent to the operator of the spotting device over the lines connecting the observers and plotting board armsetters, at such times as the lines are not being used for the transmission of data as to target position. It is contemplated in this study that the training of battery organizations will be such, that even when time for only a single line of communications between observers and armsetters has been available, the spotting detail will observe trial shots; that trial shots will be fired during the interval that the position finding detail is obtaining a satisfactory track of the target on the plotting board; that the period required to obtain a satisfactory track of the target will suffice for the completion of trial shots; and, that the interval between the firing of the last trial shot and the firing of the first shot at the target will not exceed one minute plus the time of flight. A procedure such as the above was used repeatedly and with complete success by the 51st Artillery, C. A. C., during many subcaliber and two service practices in July and August, 1923.

22. Two azimuth instruments Model 1918 or Model 1910 should be supplied to each organization for use by a spotting detail. The instruments need not be of the same model as those used by the observers. It would be advantageous if they were, and therefore the Model 1918 instrument is preferred. Under this provision, if two Model 1918 instruments are furnished then the battery can install, when time permits, a third base end station which in effect would give a battery three base lines. The battery commander's telescope (scissors type) now authorized for these organizations could be used as the spotting instrument at or near the battery.

23. An impact board of the type reported on under Coast Artillery Board Project No. 132 (Range Adjustment Board) should be issued to each of these batteries. The device can be used in adjustment of fire on fixed targets and in the preparation and regu-

lation of fire against moving targets. When observation of fire is possible the deviations determined on the spotting device may be set upon the impact board readily and a plot of the stripped range deviations thus made available for the use of the battery commander. The model of this device as constructed by the Coast Artillery Board was tested by the 51st Artillery, C. A. C., in all of the subcaliber and service practices mentioned in paragraph 21, above. It was found to be entirely satisfactory. A complete description of the construction and operation of the device is contained in Training Regulations 435-221, "Fire Control and Position Finding."

24. *a.* Eventually, a suitable spotting device should be supplied to each of the batteries. There is no single device, out of the large number of such devices which have come to the attention of the Coast Artillery Board, which is sufficiently superior to all the other spotting devices for general use by all Coast Artillery batteries to warrant a recommendation for its adoption, manufacture and issue as standard equipment. That there is need for such a device is apparent, but the advantages of some one device for some particular battery or class of artillery do not meet the needs of some other battery or class of artillery as well as some other device. Nor is the need for a spotting device as vital as the need for other articles of equipment such as a plotting board, azimuth instruments, range percentage corrector, and other devices, and for this reason some spotting devices which have merit cannot be recommended for issue to tractor batteries at least, because of the cost of arsenal production of such a device. The general requirements of a spotting device suitable for issue to Coast Artillery batteries have been stated in various reports on spotting devices and are well known to the Service. For tractor batteries, requirements as to cost, portability, speed and simplicity of operation, and universality of the device are of primary importance; in addition the device should admit the satisfactory accomplishment of the procedure outlined in paragraph 21, above.

b. The procedure of paragraph 21, above, may be restated thus: the spotting detail should observe and obtain the results of trial shots which may be fired while the observers and plotting detail are tracking the target. The reasons justifying this procedure are obvious. A suitable spotting device therefore should permit the determination of the deviations of splashes from the trial shot point when the azimuth of the splash is reported by the spotters. It should permit also the determination of the range deviations of shots fired at the moving target in which case spotters would be reporting the angular deviations from the target to the splash rather than the azimuth of the splash as in firing trial shots at a hypothetical point. It is possible to determine the range deviations of trial shots when the angular deviations from a hypothetical registration point to the splash have been determined by the spotters. It should be expected,

however, that in many cases the splashes of trial shots may not fall within the field of view of a spotting instrument which has been oriented on a hypothetical point, because of errors in determining the ballistic correction, and for this reason that it would be a better procedure to anticipate this contingency by training the spotting detail to utilize the azimuths of splashes as well as the angular deviations. A spotting device which would meet this requirement is desirable. There is none such with the possible exception of the spotting chart and the Bowler Board. The latter would be expensive to construct at arsenals. The former is not universal, but probably can be made so at little expense, as described in the September, 1923, COAST ARTILLERY JOURNAL.

c. There is another condition which a spotting device suitable for these units should meet. Splashes will occur with such great rapidity that attempts to synchronize the number of a round with any particular splash will be—have been found to be—impracticable. It has been found impracticable also to synchronize with each other the angular deviations from the stations used in bilateral spotting. The best results obtained so far have been brought about by using the angular deviations determined by the spotter at or near the battery only for correction of the deflection; and, by assuming in operation of the spotting device that all shots fall on or very near the gun target line. When good conditions of visibility exist at the target a flank spotter can report the angular deviations of more than 80 per cent of all splashes from a four-gun 155-mm. battery. Reports of deviations under target practice conditions will be sent to the operator of a spotting device every few seconds. A spotting device suitable for use by these units must permit determination of range deviations with great speed under the conditions cited. In the practices at Fort Eustis mentioned above, a spotting chart was used with complete satisfaction. The spotting chart used was not universal, but it can be made so as indicated in subparagraph *b*, above. From the standpoint of speed of operation under the above conditions, the Jones Longitudinal Deviation Ruler seems suitable and possesses some other advantages, but is not so well suited to the conditions of paragraph *b*, above, as the spotting chart, unless the procedure of using the plotting board for plotting the splashes of trial shots be followed. As indicated above, it is especially desirable, in view of the limited field of fire of these units, and the high rate of speed possessed by targets suitable for the fire of the units, that the procedure of subparagraph *b*, above, be followed by these organizations.

d. The matter of a suitable spotting device has been discussed at some length in order to bring out the difficulty in devising or choosing a device as standard. A separate report on this subject will be made later. A spotting device should be included in tables of basic allowances and until a suitable device has been adopted, battery

commanders may be expected to improvise a device good enough for the local situation.

25. A range finder should be furnished to each battery of these guns for use in the contingencies when, due to rupture or failure of communications, or to some other cause, the normal horizontal base position finding system cannot be utilized. In this connection attention is invited to the recommendations made by the Coast Artillery Board under Projects Nos. 5 and 47.

26. All of the above fire control equipment together with some of the operating personnel can be transported in a G. M. C. or similar truck. This has been demonstrated to be practicable by service tests. The remaining personnel required for operation of the devices can be transported in a reconnaissance car. Provisions for suitable transportation should be made in the table of basic allowances of equipment for these units.

The Operation of the Fire Control System

27. In the following it is assumed that an organization has been using a long horizontal base position finding system against naval targets when orders are received to withdraw and to occupy suitable positions for the defense of a distant harbor. Assume that the orders are received at nightfall today, and that these orders require that the organization be ready to fire from the new positions at dawn on the day after tomorrow. The distance and highways to the harbor are assumed to be such that it will require about 12 hours for the guns to travel to the new position.

28. Considering now the functioning of a well trained battery. The battery commander issues immediately the necessary march order for abandonment of the present position, and may direct the battery executive to take up the march to the new position at daybreak tomorrow. Since this report is devoted solely to a consideration of the practicability of the fire control methods and materiel advocated herein, it is assumed that those matters relating to the administration, supply and liaison with other and higher units are functioning satisfactorily. The march order requires the assembly of all fire control and communications equipment. Within a reasonably short time, the battery commander, the necessary commissioned and enlisted personnel, with personnel supplies, surveying, fire control and communications equipment, should be enroute to the new position. Based upon a study of hydrographic and topographic maps of the new defensive area, maps which should be obtained easily on this continent, the battery commander and others should have a clear conception before their arrival at the new position of approximately where the various gun and fire control station locations must be for accomplishment of the mission designated in orders. It should be feasible, ordinarily, for the battery commander to plan his procedure for tomorrow, to issue the necessary instructions for this fire

control and orientation party, to arrive at the new location, obtain some rest, and be prepared, by tomorrow morning, to begin the surveys and other work necessary to a horizontal base installation. The general procedure outlined in paragraph 10, above, should be followed then.

29. The above conditions are believed to be typical of the general conditions which probably will be encountered by these organizations, in actual coastal operations. A mobile artillery unit must hold itself in readiness for abandonment of any position. Higher artillery officers, who would be responsible for issuance of these orders, can be expected to be familiar with the problems attendant on such orders, and reasonable foresight on their part should be anticipated. The conditions herein are representative. They may be assumed to be normal conditions. It may be considered that conditions which do not permit of the approximate solution given herein are emergency conditions which will be met, when they arise, by emergency methods.

Preparation of Fire

30. The range detail should organize its station in a tent, truck or suitable favorably located small building, and fire control communications should be connected to this location. Attached as Exhibit "A" is a diagrammatic sketch of a suitable fire control layout under these conditions.

31. Assume that the above procedure has been completed satisfactorily; that the battery is emplaced and is ready to fire by the time specified. These assumptions are reasonably capable of complete realization. It may be assumed also that a false orientation as described in paragraph 10 *e*, above, is in use, and that only a single line of communications between base end stations, plotting room and battery is in service as yet. However, the additional lines of communications necessary to the complete installation are being run and connected as rapidly as possible, a suitable time interval apparatus is in operation, and the false orientation will be corrected at some later, more convenient time, when accurate orientation data are available.

32. The essential meteorological data should have been obtained by radio or otherwise from a meteorological station of the Signal Corps net. Thorough preparation of fire should consist of:

a. The organization of the battery position and fire control section, the orientation of gunsights, azimuth instruments, plotting boards and other devices, and the procurement of the essential meteorological and ballistic data.

b. The determination of a ballistic correction for the range at which trial shots will be fired.

c. The firing of trial shots.

d. The alteration of the ballistic correction by the amount which may be justified by the mean of the deviations of the trial shots.

33. The various uses and operation of the Cloke Plotting and Relocating Board, the Range Percentage Corrector and the Impact Board (Range Adjustment Board) are given in detail in Training Regulations 435-221, "Fire Control and Position Finding." The operation of the Pratt Range Board as it should be used by these units is given under the description of Range Correction Board, Model E 1923, in the same training regulations.

34. *a.* When a target appears, designation and identification of the target should be made in accordance with the usual Coast Artillery practice. The battery commander should determine the fuse, shell, normal charge or supercharge, tactical fire, such as Case I (if a direct fire telescope be used), Case II or Case III, and whether one or more guns shall be used for trial shots. He should be responsible for the selection of the trial shot point and should designate the number of trial shots to be fired, the interval between rounds, if more than one gun be used, and the time for beginning fire at the trial shot point.

b. Not less than four trial shots should be fired by such a unit. Trial shots should be fired carefully, deliberately, as rapidly as is consistent with precise laying, and without considering the time interval system. The trial shot point should be selected, whenever practicable, on the probable course of the target, and preparation of fire as defined above should be completed before the target arrives at the trial shot point. The interval between the discharge of the last trial shot and the discharge of the first shot at the target need not exceed one minute plus the time of flight of projectile. Case III fire should be used in firing trial shots unless a registration point such as a buoy or point of land can be utilized.

35. *a.* The range and azimuth of the trial shot point from the directing point or directing piece of the battery, and the azimuth of the trial shot point from each observing or spotting station should be determined on the plotting board. The azimuth of the trial shot point from each spotting station should be sent, by the Cloke Plotting Board armsetters, to the respective spotters, or called to the operator of the spotting device for transmission to the spotters. The spotters should set their instruments at this azimuth, verify the setting, repeat same to the armsetters or operator of the spotting device and announce by telephone to the battery commander and range officer their readiness to observe trial shots. The range to the trial shot point should be called aloud by the plotter, and the azimuth from the directing piece should be called aloud by the relocating armsetter, but these data should not be transmitted to the spotters. In case the installation of the separate spotters line has not been completed and only a single line to the observation station is being used for both observer and spotter, the spotter who

is located at or near the battery must not confuse the gun azimuth, should he hear it, with azimuth already set on his spotting instrument.

b. The operator of the wind component indicator should set upon that device the azimuth of the trial shot point and the azimuth and velocity of the ballistic wind. He should call to the operator of the Pratt Range Board the range component of the wind, and to the operator of the deflection board, the deflection component.

c. The correction ruler of the Pratt Range Board should be set at the range to the trial shot point. The range board operator should determine the proper ballistic correction as indicated by the markers on his board and should call the total correction indicated on the correction scale of the correction ruler to the operator of the range percentage corrector.

d. The range for trial shots as called by the plotter should be set opposite the zero of the range percentage corrector. If desired, the approximate elevation may be called by the operator of this device for transmission to the guns. Both pointers of the range percentage corrector should be in coincidence and at the zero. The operator should move both pointers along his ballistic scale so that they indicate the total correction called by the range board operator. As indicated by the "read" pointer, the operator of the range percentage corrector should call to the operator of the deflection board and for transmission to the guns, the corrected elevation for the designated charge.

e. The operator of the time elevation device should transmit immediately to the elevation setters at the guns the approximate elevation if called by the operator of the range percentage corrector, saying "*approximate elevation* —— mils." He should transmit immediately to the elevation setters at the guns the corrected elevation received from the operator of the range percentage corrector, saying "*trial shot elevation* —— mils."

f. The deflection board operator should set on his device the trial shot azimuth called by the relocating armsetter. He should determine the correction for drift at the elevation called by the operator of the range percentage corrector, and the correction for wind as indicated by the deflection component of the wind as called to him by the operator of the wind component indicator. He should call to the operator of the time azimuth device the corrected azimuth of the trial shot point as indicated on the deflection board.

g. The operator of the time azimuth device, if desired, should transmit immediately to the sightsetters at the guns the azimuth of the trial shot point as called by the relocating armsetter, saying, "*approximate azimuth*——mils." He should transmit immediately to the sightsetters at the guns the corrected azimuth called to him by the deflection board operator, saying, "*trial shot azimuth*——mils."

h. The operator of the Impact Board should set the slide which is used to convert deviations from yards to percentages, to the range called by the plotter.

i. The operator of the spotting chart prepares to determine range deviations from the trial shot point, from the azimuths of splashes reported by the spotter. The operator of the spotting device should set his board in conformance with the data called from the plotting board. He should keep in touch with the flank observer so that he may notify him when the first trial shot is fired. He may further assist the observer by timing the flight of the first projectile on a stop watch and notifying the observer a few seconds before the splash is due.

36. *a.* As noted in paragraph 21 and paragraph 24 *b* and *c*, the spotters should observe the fall of trial shots. Assuming that the device used is a spotting chart, the range deviations of trial shots may be obtained as follows:

b. The spotter located at or near the battery should report the azimuths of trial shots to a man in the plotting room, who, during the subsequent fire at the target should note on a blackboard all deflection deviations reported to him. This man should stand near the operator of the spotting device while the splashes of trial shots are being observed. He may call to the operator the azimuths of trial shots splashes as reported to him by the spotter near the battery, or he may mark each azimuth on paper where this operator can see it; or he may select the ray corresponding to the azimuth called to him and thus aid the operator in obtaining intersection with those azimuths which will be called by the flank spotter to the chart operator.

c. The spotting chart operator should locate the position of each trial shot splash on the chart. Using a small scale, he may measure each deviation as soon as obtained and call this deviation to the operator of the Impact Board (Range Adjustment Board) who may sit facing him. As soon as the deviation of the last splash has been called to the Impact Board Operator, the chart operator should locate the center of density of trial shots on his chart and should measure the mean deviation as a check against the result which will be determined on the Impact Board.

d. The operator of the impact board should set upon successive slides of his device the range deviation called by the operator of the spotting device, or he should convert the range deviation

NOTE: If a universal spotting chart be not available, it should be noted that a small spotting chart suitable for use in determining trial shot deviations can be made very quickly. The angle at the trial shot point and the range and azimuth of this point from each spotting station may be determined quickly on the Cloke Board. Assuming that the ballistic correction as determined on the Pratt Range Board will not be very greatly in error, trial shots should fall within 500 yards of the target. The deflecton error should not be large. A small chart approximately 10 inches by 5 inches should suffice. The center of the chart may be taken as the trial shot point. Using the plotting board data a ray to the battery and to each spotting station can be drawn on the chart. At the usual ranges for trial shots there will be no appreciable error if rays parallel to these be used as indicated above. When a spotting device suitable for using either azimuths or angular deviations is not available, and when time permits such a chart may be utilized advantageously.

into percentage deviations by reading on the slide at the top of his board the percentage corresponding to the deviations called to him. He should set the deviations on successive slides. When the deviation of the last trial shot has been set by him upon his device, he should estimate the position of the center of density of all splashes, move the zero of the next slide to the estimated position, read, and call to the operator of the range percentage corrector the mean deviation of the trial shots.

37. While trial shots are being fired the base end observers should be tracking the target. Assuming that the time interval system gives three buzzer notes in the telephone receivers every 30 seconds, the observers should track in the manner prescribed in regulations, except that during the period when trial shot data are being transmitted to the plotting room such data may have priority in transmission over data concerning the target. This provision is based also on the assumption that only one line of communications has been installed as yet. The reason for the procedure is that no predictions need be made upon the plotting board until the last trial shot has been fired. Where but a single line of communications is available the azimuth of the target at each bell may be sent at some convenient time before the next bell. After the last trial shot has been fired all azimuths must be reported on the bell in accordance with the prescribed usual method of tracking. The command for transmission of azimuths "on the bell" should be, "*Next bell, time one.*"

38. *a.* Meanwhile, the situation on the Pratt Range Board has not been changed. The correction for alteration of the ballistic correction has been determined on the Impact Board (Range Adjustment Board), has been called by the operator of that device, and its magnitude has been checked by the operator of the spotting chart. The operator of the range percentage corrector should move his "read" pointer until the magnitude of this alteration is indicated upon his arbitrary correction scale. The operator of the Pratt Range Board should check this operation of the range percentage corrector and thus verify the magnitude of the altered total correction as called by the latter operator.

b. The operator of the Pratt Range Board should incorporate the results of the trial shots (as determined on Impact Board) and as shown on Range Percentage Corrector), as a correction of the assumed muzzle velocity, by moving the pointer to the velocity curves until the total correction shown on the correction scale of the correction ruler is so altered as to be identical with the total correction shown by the "read" pointer on the ballistic scale of the range percentage corrector. The Pratt Range Board operator then should move the velocity marker to the proper position. He should call "*Marker Set,*" or give some other suitable signal to notify the plotting detail that preparation of fire has been completed.

c. As soon as the last trial shot splash has been reported to the spotting board operator, the spotters should turn their instruments upon the target and should follow same prepared to report deviations of all further splashes seen by them, as *angular deviations,* right or left, from the target.

d. At the signal of the Pratt Range Board operator, the operator of the Impact Board should set all slides at zero. The blackboard operator should take his position at the blackboard with chalk and eraser and should be prepared to record all deviations called to him by the spotter at or near the battery. The operator of the range percentage corrector should bring both pointers on his device into coincidence at the total ballistic correction. The deflection board operator should set upon his device as a wind correction the group deflection deviation called to him by the spotting chart operator.

39. The above operations should complete preparation of fire. Although given in considerable detail and requiring good training for satisfactory accomplishment, the interval between firing the last trial shot and firing the first shot at the target need not be longer than one minute plus the time of flight of the projectile. That the above is a practicable procedure was demonstrated repeatedly at Fort Eustis during 1923.

Regulation of Fire

40. In regulating fire upon the moving target, there should be available already upon the plotting board a track of sufficient length for prediction of setforward points. Beginning at time one, and using the direct method of plotting as prescribed in Training Regulations 435-221, predictions should be made every 30 seconds using a 30-second predicting interval. Location of the setforward point may be made by a freehand prediction using the pantograph predictor as an aid, or in some other equally satisfactory manner. The plotter should call out the range and the relocating armsetter (in Case III) the azimuth to each setforward point.

41. The Pratt Range Board operator should move the correction ruler to the range called by the plotter and should determine the total ballistic correction. If Case I fire is to be used he should not include in this total correction the effect indicated by the curves for height of site. This will accept the theory of rigidity. In particular cases where the acceptance of the rigidity theory introduces an error worth consideration, a correction can be made (by a proper range correction board curve). He should call the total correction to the operator of the range percentage corrector and thereafter should operate his board continuously, deliberately, and as prescribed in Training Regulations 435-221, "Fire Control and Position Finding."

42. Using the ranges and azimuths called from the plotting board, the operator of the wind component indicator should determine from time to time, new range and deflection components of the wind values. When he notes a change in these components he should call the range component to the range board operator and the wind component to the deflection board operator. The latter operators should be trained to expect such changes from time to time.

43. The range percentage corrector operator should set immediately at the zero of his ballistic correction scale each setforward range called by the plotter. He should have set upon his ballistic correction scale the last ballistic correction called by the Pratt range board operator, or as read by him on the correction ruler of the Pratt range board, if such reading be found practicable of accomplishment by convenient grouping in the plotting room of the various fire control devices. He should continue to set upon his device each ballistic correction determined by the operator of the Pratt range board.

44. *a.* The operator of the time elevation spiral should mark upon his device the corrected elevation just determined upon the percentage corrector. A description of the operation of the time elevation and time azimuth devices is contained in the report on Coast Artillery Board Project No. 222, "Time Range and Time Azimuth Interpolating Devices."

b. In visualizing the details of the operation of the time elevation and time azimuth devices for these units it should be remembered that the time elevation spiral operator, time azimuth device operator, elevation setters, and azimuth setters hear buzzer notes in the receivers as follows: one note at 10 seconds two notes at 20 seconds, three notes at 30 seconds, one note at 40 seconds, two notes at 50 seconds, three notes at 60 seconds, etc.

c. The observers report the azimuth of the target at every three notes, or each 30 seconds. Prediction should be made every 30 seconds to a setforward point which is, in time of travel along the targets course, 30 seconds plus the time of flight in advance of the position of the target as just reported and located on the plotting board. The operations in the plotting room leading up to delivery of the corrected elevation for this setforward point to the time elevation spiral operator should require little more than 10 seconds to complete on an average. The elevation just marked upon the spiral should be set upon the guns just at the time three notes of the buzzer

NOTE: Both pointers of the percentage corrector should remain in coincidence until a correction based upon observed deviations of fire at the target, as shown upon the impact board, has been ordered by the battery commander or range officer; then the reading indicated by the "read" pointer of the range percentage corrector on the arbitrary correction scale should be indentical with the setting of that slide on the impact board which indicates the amount of the correction ordered by the battery commander or range officer. The operator of the range percentage corrector should call to the operator of the time elevation spiral or similar device, or that operator may read for himself, the corrected elevation shown by the "read" pointer corresponding to the range just called by the plotter. He should check also the elevation marked upon the time elevation spiral by the operator of that device.

are heard in the receivers. For Case I, the elevation setters at the sights should be trained to "creep" in elevation and if corrected elevation be delivered to them every 10 seconds they will be guided in performing this operation so that the error should be practically non-existent. When firing by Case II or Case III the elevation should be delivered to the elevation setter every 10 seconds (or 15 seconds, depending upon the rate of fire) and each elevation should be sent sufficiently in advance of the time for which it applies so that the elevation setter can perform the operations of setting the elevation on his quadrant and then levelling the gun by the proper time.

d. It is evident, then, that the first elevation set upon the spiral should be sent to the elevation setter immediately after two notes are heard in the receiver, so that it may be set upon the guns by three notes, the time for which it is correct. When the spiral operator marks this elevation on the spiral he should mark the figure (2) alongside the elevation as a reminder that he is to transmit this elevation just after two notes of the buzzer or bell. Thirty seconds later, and probably just after one note has been heard by him, he should receive another corrected elevation which also should be marked (2) on the spiral. He then should subdivide for (1) and (3) at the proper places of interpolation so that reading ahead from the next to the last (2) the markings on his spiral will read (2)—(3)—(1)—(2). He should send the elevation marked (1) to the guns immediately, provided two notes of the buzzer have not yet been heard by him, and in general they will not have been heard if the plotting organization be fairly well drilled. He then should extrapolate an equal distance (one-third), should mark (3) at this elevation, and should continue the process as indicated, sending the elevation marked (2) after two notes, (3) after three notes, (1) after one note, and so on. The designations (1), (2), (3), mean to him that after hearing the corresponding note in his telephone receiver, he is to telephone to the elevation setter at the guns the elevations thus marked. To the elevation setters at the guns the elevation received by them means, whenever received, that they should have that particular elevation set upon the guns by the next bell or buzzer note. In case elevations are to be transmitted at 15-second intervals the time interval system should be adjusted for three bells or buzzer notes and one bell or buzzer note alternately at intervals of 15 seconds, and the operation of the time elevation spiral modified accordingly.

45. The operator of the deflection board should keep the device set for the elevations being sent to the guns, he should keep the proper wind component set upon his device and in Case I or Case II fire should call to the operator of the time azimuth device the corrected deflection for transmission to the guns. In Case III fire he should set upon his device the azimuth of the setforward point as called by the relocating armsetter, should apply the necessary cor-

rections just mentioned for deflection and should call the corrected azimuth to the operator of the time azimuth device, or that operator may read for himself the corrected azimuth. He should check also the setting of the corrected azimuth upon the time azimuth device.

46. When Case III fire is being used, the operator of the time azimuth device should perform corresponding operations in azimuth upon his device as are prescribed in paragraph 44, *a*, *b* and *c*, above, for the time elevation spiral. He should transmit the deflections received from the deflection board operator for Case I and Case II fire. He should be connected by telephone to the sightsetters at the guns.

47. The operator of the Impact Board should keep the conversion slide rule at the top of his device set at the ranges called by the plotter. In the beginning of regulation of fire he should have all shot slides set at zero. When a deviation is called to him by the operator of the spotting device, he should convert this deviation from yards to percentage and should indicate this percentage deviation at its proper place opposite the first shot slide of the board. The next deviation received should be indicated opposite the following slide, no effort being made to synchronize the number of the round with any particular splash because of the frequency with which splashes may be expected to occur. The reading upon the last slide should correspond always with the reading upon the arbitrary correction scale of the percentage corrector. The operator should not move any shot slide to the center of density of such splashes as may be observed during fire at the target. The responsibility for making corrections based upon deviations rests upon the battery commander, who may, if he chooses, delegate this responsibility to the range officer, who should move to the apparent center of density a slide sufficiently in advance of the last slide which records a deviation. This officer should record the number of the slide moved and the magnitude of the correction thus ordered; he should be responsible for the proper application of this correction upon the percentage corrector. In general he should not require its incorporation into the range board as a velocity correction. The operator of the impact board should be held responsible for the proper setting of all slides other than those moved by the battery commander or his delegated subordinate. He should be sure that the slide to be used at the time of a reported deviation has the same setting as is used upon the arbitrary correction scale of the percentage corrector in order that his device may show at all times the stripped deviations of such shots as may have been observed. The detailed operation of this device is given in Training Regulations 435-221.

48. The operator of the spotting device should determine upon his board the range deviations corresponding to the angular deviations reported to him by the flank spotter. The correction for deflections and range deviations should be treated as separate problems. Deflection corrections should be made first, so that in obtaining

these deviations he may assume that all splashes observed were on the Battery-Target line. He should call each range deviation determined by him to the operator of the impact board.

49. The man connected to the spotter located at or near the battery should record upon a blackboard the deflection deviations reported to him by that spotter. This man may record also the results of airplane spotting when such observation is available.

50. A correction based upon observation of fire should be applied only when there is sufficient evidence to indicate a great probability that such a correction is warranted. A thorough comprehension of the mechanics and technique of fire control is a necessary attribute of an efficient Coast Artilleryman. If the procedure outlined for preparation of fire be accomplished properly and thoroughly, then properly regulated fire at an enemy ship can be expected under those conditions of visibility which we may reasonably anticipate. Whether the splashes of any shots fired at an enemy ship can be identified and the deviations measured is pure conjecture. That some may be observed and identified is of some probability, especially those splashes which may be short. If splashes can be identified and observed, and the target can be tracked by a flank observer, then in general the range deviations of observed splashes can be obtained. The probability that at times fire on enemy vessls may be susceptible to observation is sufficient justification in itself for a spotting installation, in order that we may overlook no opportunity to deliver the maximum of effective fire in engagements with naval vessels. There are and can be no hard and fast rules of procedure or so-called methods of adjustment for the regulation of fire against moving targets. There is no easy road to efficiency in this matter. The procedure of preparation and regulation as outlined is practicable and should be effective. The effective prosecution of the procedure depends principally upon two vital factors: *a*. The training of the battery; *b*. the judgment of the battery commander.

51. However representative of measures for meeting normal conditions the above procedure may be, it is evident that unusual or emergency conditions may be encountered, as for example that a target appears suddenly at a time when especially good conditions of visibility exist at the target, that preparation of fire as outlined above may not be practicable of fulfillment, or that the communications of the horizontal base line may fail. Such conditions may be met if necessary by special methods.

52. When the horizontal base installation cannot be used (this probably precludes flank spotting also) the range finder should be placed in service and the rate of change in range and angular travel determined by the plotting room detail. Corrections to the range finder ranges may be applied by the plotting room detail using such of the fire control equipment—Pratt Range Board, range percent-

age corrector, deflection board, etc., as may meet the conditions of the moment. At ranges less than 6000 yards, a portable 4-meter base range finder may be expected to supply fairly accurate range data. The best indication which the battery commander can have as to the effectivness of his fire when measured range deviation cannot be obtained, is that the proper proportion of shots are observed to fall short. He should correct the range finder ranges as best he can so as to bring about this condition. It may be of some value to utilize the ladder of dispersion of the gun at the approximate range to the target in attaining this balance of the proper number of shorts, but this procedure should not be confused with the bracketing method as ordinarily described. In view of the ranges which must be considered, sensing is very likely to become guessing even when an instrument is used, and it should be noted that even when sensed correctly with respect to the target a splash may be actually the opposite in sense if it could be sensed with respect to the point of expected range. It is then clearly evident that when a setforward point is used either with a range finder or horizontal base position finding system, even though a splash be sensed correctly with respect to the target, the sensing may not be correct with respect to the setforward point. In the case of a fixed target, a sensing with respect to the target is also a sensing with respect to the point of expected range. For fire on moving targets it is only when a splash is sensed far over or far short that a sensing may be relied upon as a good indication that both the splash and the point of expected range, or setforward point, are sensed correctly. Under such conditions the correction applied should be a bold one and there is no sound reason for verifying such a miss as is now prescribed for use in bracketing as defined in Field Artillery Firing and other works on gunnery. One should be extremely conservative in the application of corrections based upon sensings when shots are observed to fall in the immediate vicinity of the target because as noted above, for a fast moving ship, sensings of splashes silhouetted against a vessel or the reverse very likely may be entirely misleading. In this case the battery commander will do better if he relies for effectivness upon the dispersion of his guns and the laws of probability.

53. There exists the possibility of unusually good conditions of visibility in the vicinity of the target with the possibility of the occurrence of conditions which might preclude a thorough preparation of fire. Under such conditions fire may be opened directly on the target beginning either with or without ranging shots. The detailed procedure given above should function satisfactorily with but minor changes to accommodate ranging shots. The fire should be continuous and at the maximum rate for the battery. The fire should be regulated by the application of such corrections as may seem warranted by the observed deviations. The minor changes necessary in the above normal procedure may be obtained from the

descriptions of the various fire control devices, contained in Training Regulations 435-221.

54. It is the opinion of the Coast Artillery Board that there has been a general tendency since the war to attempt to apply to moving targets, methods for control of fire which very properly apply only to fixed targets. This tendency is especially noticeable when 155-mm. gun units are considered. So pronounced is this tendency that even now Coast Artillery National Guard units are being trained primarily in land warfare methods. Instructions for such training must be based upon complete disregard of the fact that fire upon a moving target is a special problem and that Coast Artillery organizations only are trained for such fire. This training appears to be a violation of the principles of the "Positive System of Coast Defense," which is established doctrine, as well as of Training Regulations 10-5, "Doctrines, Principles and Methods, Basic." Our national policy is expressed in the "Positive System of Coast Defense." The mobile artillery usage contemplated therein requires special training which is embraced only in Coast Artillery doctrine. A mobile unit trained primarily for fire upon fixed land targets cannot be expected to deliver effective fire upon the fast moving ships which will be encountered in coast defense oprations.

55. It is probable that the development of Coast Artillery doctrine for fire upon moving targets will be furthered if every vestige of fixed target conceptions be erased from this doctrine. Their inclusion in our doctrine is a result of the intensive preparation for position warfare of 1917-1918. It appears that Coast Artillery doctrine just prior to our entry into the war was an excellent and far-sighted conception—even the target practice restriction on corrections was inherently sound if the most probable conditions of an action be visualized. Minor weaknesses in this doctrine were that it permitted a considerable delay to follow preparation of fire and that current instructions then could be interpreted as absolutely precluding correction of fire when there might exist positive evidence to warrant such correction. The fallacy has grown in the minds of many Coast Artillerymen that those land artillery methods which were found most effective in the World War should be the best basis for developing Coast Artillery doctrine for future wars, yet these land artillery methods never had been given, even at the Dardanelles, the test of attempted employment against fast moving ships. A return to the older doctrine as a basis for development is inevitable. The soundness of this older doctrine is compelling such action. The sooner a return is brought about, the more rapidly will this doctrine develop. It is becoming more and more apparent that the convictions of the Coast Artillery Board as evidenced in the report on Project No. 114, Preparation and Regulation of Fire Against Naval Targets, are finding confirmation in the minds of mature and experienced artillerymen. It has been

recommended that 155-mm. guns be issued to National Guard units as a basis for training these units in Coast Artillery fire control. It is evident that our moving target doctrine should be purged of fixed target conceptions as soon as possible.

56. The doctrine, materiel and procedure outlined in the foregoing study are not only necessary and desirable for fire on moving targets, but are applicable, with minor changes, when those units, organized as described in the preceding paragraphs, are employed against land targets. The Coast Artilleryman should be familiar with the terms and methods employed in land warfare by the Field Artillery, and, with reference to this land warfare, the Coast Artillery and the Field Artillery should speak a common language. But, so far as Coast Artillery is concerned, the proper place to teach the common language and common technique is solely in connection with instruction in the use of Coast Artillery materiel in land warfare. Coast Artillery is now employing terms in moving target practice which are really applicable only to land target practice. The use of such a term as "improvement fire" appears to be an unnecessary distinction as to the phase of regulation of fire at naval targets. The term implies that not all fire on the target is for effect, that only part of the fire requires to be or should be improved, and implies further the idea of discontinuity in regulation of fire. The use of the term "improvement fire" and such terms as "bracketing" and "trial elevation" results in some confusion in Coast Artillery training rather than making for clarity in Coast Artillery procedure. Such terms as are strictly applicable to fire at both fixed and moving targets should be retained, but where fixed target terms are not strictly applicable to moving target problems, they should be eliminated from the list of moving target terms and, where necessary, a proper descriptive designation given. For example, the verification of a miss under certain condition is essential to proper procedure in adjusting by the Bracketing Method as prescribed in Field Artillery firing. The procedure of not verifying such a miss in moving target firing is now permitted by Coast Artillery Memorandum No. 4. Calling this procedure in C. A. M. No. 4, a "Bracketing Method of Adjustment" is not only confusing the definition of what should be a well understood term in artillery language, but the procedure itself is of questionable value for Coast Artillery usage.

Conclusions

57. The missions indicated in paragraphs 1 and 2 are well within the capabilities of the 155-mm. gun. The organizations therefore should be equipped for fire upon both fixed and moving targets.

58. The primary mission of these cannon is coast defense. The organizations should be trained primarily for that mission.

Such training will enable the units to fire effectively on fixed targets also, but were they trained primarily for fire upon fixed targets they could not be expected to deliver effective fire against the more important moving target.

59. For accomplishment of the primary mission, a horizontal base position finding system including a plotting board should be provided, together with a portable range finder for emergency use.

60. If the organization be trained properly it should be practicable usually to make surveys and to install the communications necessary to a long horizontal base position finding system without causing delay in opening fire. All mobile seacoast artillery units should receive the requisite training for the rapid installation of such a position finding system.

61. Table IV-G, Circular No. 373, War Department, 1920, Basic Allowances of Equipment Special for Coast Artillery Corps, should be revised to include the fire control equipment, communications equipment and transportation indicated in the above study.

62. The tables of organization for 155-mm. guns, peace and war strength, should be revised to include the personnel necessary for the fire control system outlined in the above study. Provisions should be made in these tables for the inclusion of mobile searchlights. Reference is had to Coast Artillery Board Project No. 143, "Searchlights for Mobile Coast Artillery."

63. There is some question as to the suitability of the ammunition now allotted to these guns, when this ammunition is to be used on naval targets. The ammunition should be suitable for use on unarmored or lightly armored vessels, and for effect upon the personnel of landing parties in small boats. In addition the land warfare requirements should be met.

64. The procedure for the preparation and regulation of fire as outlined in the above study is very well suited to these organizations. It is in effect a statement of the common seacoast artillery doctrine. It is adaptable to naval or land warfare requirements because the problem of delivering effective fire upon a fixed target is a special phase of the problem of delivering effective fire upon a moving target. In order to insure that 155-mm. gun organizations will receive the proper training for the accomplishment of the principal Coast Artillery mission, and in view of the need for coordination of fire control developments among those organizations which are scattered widely throughout the nation and its possessions, it is believed that the above study, if approved by the Chief of Coast Artillery, should be mimeographed and distributed throughout the Coast Artillery Corps, Regular, National Guard and Reserve units, as a memorandum for training of 155-mm. gun organizations.

RECOMMENDATIONS

65. It is recommended: *a.* That the fire control system of 155-mm. gun organizations consist of a long horizontal base position finding system, including suitable communications, and a portable range finder for emergency use. *b.* That the following be added to Section V, Table IV-G, Cir. 375, War Department, 1920, as equipment per gun battery: 1 Cloke Plotting and Relocating Board, complete; 1 Pratt Range Board; 1 Pantograph Predictor; 1 Range Percentage Corrector; 1 Wind Component Indicator; 1 Deflection Board; 1 Time-Elevation Spiral, or similar device; 1 Time-Azimuth device; 2 Azimuth Instruments, Model 1918, or Model 1910; 1 Impact Board (range adjustment board); 1 Spotting Device; 1 Range Finder.

c. That there be eliminated from Section V of the said table, the following: Devices *(Computing)*—Range, Wilson, 1 per battery; Deviation, Unkles, 1 per battery.

d. That there be added to Section IV, Surveying Equipment, of the said table, the following per gun battery: 1 Tape, steel, measuring 500 feet, graduated in feet; 1 Clamp, chainman's, for use with 500-foot tape.

e. That Section VII of the said table be modified, as a result of final action upon Coast Artillery Board Project No. 111, Fire Control Telephone Systems for Fixed and Mobile Artillery, and Project No. 200, Test of Motor and Clock Driven Time Interval Apparatus for mobile artillery units, to include a suitable communications equipment.

f. That Section IIIA of the said table be modified in accordance with final action upon Coast Artillery Board Project No. 131, Panoramic Sights for Mobile Artillery, and Project No. 151, Subcaliber Equipment for 155-mm. guns.

g. That Section VIII of the said table be extended to provide for each battery a suitable truck for the fire control equipment and a reconnaissance car for the transportation of orientation personnel.

h. That the Ordnance Department be requested to study and report on the suitability, for the primary mission of Coast Artillery 155-mm. gun organizations, of the ammunition now prescribed in Section IIIA of the said table; and based upon the action resulting from the Ordnance Department's report, that Section IIIA be revised if necessary. It is noted that this recommendation may result in changes in the range tables and in the charts for Pratt Range Boards.

i. That Tables of Organization 143-P to 148-P, inclusive, 143-W, and such other peace or war strength organization tables as may be affected by this study be revised and extended to include the requisite fire control and other personnel; and there be included in

each 155-mm. gun regimental table of organization and table of basic allowances of equipment, provisions for a suitable searchlight organization for use with these units in Coast Defense operations.

66. It is further recommended that this study, if approved by the Chief of Coast Artillery, be mimeographed and distributed to all Regular, National Guard and Reserve Coast Artillery officers and organizations as a training memorandum and as general information on policy.

67. It is recommended that a copy of this project with the action of the Chief of Coast Artillery thereon, be furnished the Militia Bureau.

68. It is recommended further: *a.* That Major G. Ralph Meyer, C. A. C., Captain Robert N. Mackin, Jr., C. A. C., Captain George W. Whybark, C. A. C., be commended for their excellent work in connection with the development of a fire control system suitable for use by 155-mm. guns in coast defense and land warfare.

b. That Lieut. Colonel James B. Taylor, C. A. C., be commended for his professional zeal in connection with the development of communications materiel suitable for use by mobile artillery in coast defense and land warfare.

c. That the 51st Artillery, C. A. C., be commended for excellent work in connection with the development of a fire control system suitable for use by 155-mm. guns in coast defense and land warfare.

TEACH CITIZENSHIP

The best hope of America here is through instruction of the young. No child should be allowed to grow up or to go through school unmindful of the daily demands that citizenship in America makes upon the individual. There must be developed a sense of responsibility to one's self. It is neglect of this duty in training of the young that opens the way for the parade of the demagogue, the unbalanced radical and the lukewarm patriot. These elements have a dangerous hold on America today. A sturdy patriotism, mindful of its obligations, should rout them.—*Kansas City Star.*

EDITORIAL

The National Defense Test

FOR many months the War Department has been working on a plan for testing the defense strength of the Nation in case of an emergency. September 12th has been set aside for this most interesting event. It will include not only mobilization of our military forces, but as well, those of our industrial and commercial resources which would be called upon in case of war. Mobilization in its full sense would mean the mustering of all the manpower of the country needed during the first stages of a war. This of course would be a tremendously expensive procedure, and moreover, disturbing to the commercial life of the country. As contemplated, it will see only the mustering of all the Regular, National Guard and Reserve forces for one day. It will be not only a mobilization, but in addition, a demonstration of the loyalty and patriotism of the manhood of our country who stand ready to defend in case of need. It will be a test of our National Defense Act, and will afford opportunity for the people of the country to understand its provisions—an understanding they must acquire if the Act is to be long-lived.

When this country was forced into war in 1917 the admiration of the world was excited by the enterprise displayed in preparing for our great effort, but it was not until the clouds of war cleared away that the terrible cost of this undertaking was realized—a cost that was doubled and trebled because of unpreparedness—and not until then was it realized that under different conditions, the delays, confusion, lost motion and lack of mobilization plans would have jeopardized the very liberty of the people of this country. It is with a view of preventing a recurrence of such a condition that the Defense Test is being undertaken. Great commercial and industrial organizations have been requested to study the mobilization project and to consider the plans that will be necessary to transfer their plants to meet the military situation in case of need. It is safe to

say no such important military event in time of peace in the history of this country has ever taken place.

The Chief of Coast Artillery in a letter to the Commandant, Coast Artillery School, in discussing the plans submitted by the Commandant for the mobilization of the School in the Defense Test, stated in part as follows:

> The publicity given the "Defense Test" Project of September 12, 1924, by the War Department has received very favorable comment in all sections of the country. As you know, the success of the national defense policy depends primarily on the American people understanding the War Department's Mobilization Plan, the methods of execution and the cooperative effort assigned each locality. The Defense Test is designed to bring about such an understanding and to encourage all citizens to study the problem and to participate in its solution. * * *
>
> I have been asked unofficially to interest the officers of the Coast Artillery Corps in this matter, to the end that they will send brief explanations of the objectives, purposes, etc., to their friends and associates wherever located, in order that greater interest in the matter may be aroused throughout the United States. If each officer can make a personal explanation, no matter how brief, to his friends in civilian life it is believed that they will help the cause along. I hope that you will pass the word along to all officers on duty at the School so that they may know that such action on their part is desirable.

General Pershing has stated that the purpose of the Defense Test is to demonstrate to the American people the necessity to have some preliminary organization in order to avoid the danger of delay in the event of war. He desires that the American people realize the expediency and wisdom, in fact the necessity of having some sort of foresight in this matter. He points out that the Defense Test will be a most suitable manner of commemorating the anniversary of the victory of the American Army at St. Mihiel, and has recently stated as follows:

> The primary purpose of the Defense Test is to enable our people to visualize the initial processes necessary to muster our forces for National Defense. * * *
>
> The Defense Test will demonstrate and explain what preparation for national defense means in our country. It is to be a day given to patriotic gatherings by citizens of every community, during which every one will learn his place and portion in the defense of the country should our security be threatened. * * *
>
> In past emergencies we have had no plans and, relying upon hastily created forces, have suffered from the extreme confusion incident to sudden expansion. Now that a scheme has been devised to carry out the terms of the National Defense Act, we purpose to afford the people an opportunity to become familiar with the principles upon which it is founded. The keynote of any military plan is organization. This test will be a try-out for our small Regular forces and the National Guard, but more especially will it show the preliminary steps required for the prompt utilization of our large reserve force of patriotic citizens.
>
> In the World War after enormous expenditures, and serious loss of time in construction and transportation, we eventually concentrated masses of untrained

individuals in a few centers, distant from home ties and associations, where they were segregated and trained with the utmost difficulty. Profiting by these experiences, a policy exists today which contemplates skeleton units partially trained in advance, which can be concentrated locally when necessary. In an emergency, the change must be rapid and, to be effective, must be without confusion, and the smoothness of the transition is dependent upon the perfection of the plans and their comprehension by the general public.

Units of the Regular establishment and the National Guard which have been fitted into appropriate places, constitute our first line of defense and are ready to take the field without delay. Their actual preparation would consist in recruiting them to full strength and in arming, equipping and completing the training of the additional personnel needed for this purpose. The ability and foresight of both our Regular and National Guard contingents to handle these questions will be observed during the proposed test.

Behind this first line we have the great body of reserves which will constitute the bulk of our armies. The units of this force have been allocated to sections of the country according to population, and the character or occupations of the people in each community. Reserve officers have been assigned to local units or groups of this skeleton force, and the "Defense Test" will be a trial of their knowledge of the duties which will automatically devolve upon them to recruit, shelter, equip, supply, train and otherwise care for their respective organizations.

While the general requirements to be met in each of the nine Corps Areas into which the country has been sub-divided, have been set forth, the fundamental idea of our defensive plans is founded on the principle of local organization. The system follows the chain of military responsibility, until the commander of each company is given his share in the task. His plan of action must take into consideration the neighborhood facilities for recruitment, assembly, shelter, equipment and training of his unit. He is in direct contact with his home people whose interest and spirit are invoked in his aid.

Our Military System Works

Reprinted from the Washington Herald

Recently many questions have been asked about the National Defense act, one of the most constructive pieces of legislation passed in recent years. It ranks in importance with the Federal Reserve act and the transportation act in its important effect on national policy.

Until the National Defense act was passed in 1916—there have been important amendments since—the United States never had a real military policy. More lives were lost and more money wasted because of the lack of organization and plans at the opening of our various wars than from all other causes.

Much of this lack of preparedness for an emergency was due to a false idea that peace and democracy would be jeopardized by any

carefully devised military policy that might be put into effect. The reverse was true, we learned, when we tried it. Dependence on a regular army would not promote the democratic idea of military service. And if the citizen soldier was to be relied upon his interest and the nation's interest demanded that he be trained.

The National Defense act declares that there is one Army of the United States, divided into three component parts—the Regular Army, the National Guard and the Organized Reserves.

That one statement has wiped out most of the bad feeling that has, at one time or another, existed between the various branches of the armed forces. The cooperation that now exists is a new and fine thing.

The National Defense act recognized the fact that military service is a duty inherent in citizenship, just as jury duty and police duty in emergencies is. That is democratic. There is no militarism in that, just plain American common sense.

The three components of the Army differ chiefly in the amount of time they give to military service—the Regular Army, full time on full pay; the National Guard, part time on part pay; the Organized Reserve, just as much time as its members desire with no pay, except that its members can apply for certain training on a pay status.

But we now have skeleton divisions, fully officered, so that if an emergency occurs we can call to the colors instantly over 80,000 officers, each of whom would go instantly to his appointed place and job and begin to plan for, supply and organize his unit. That is national defense and safety, without the slightest danger of militarism.

Best of all, the result of the National Defense act has been the closer contact between regular, guardsman, reservist and the civilian population. It has democratized the system and has brought to the people a better understanding of the real problems of national defense and patriotic service.

Young men would do well to ally themselves with the branch of the service they best can join. The Reserve Officers' Training Corps in schools and colleges is one way, the Citizens' Military Training Camps are another possible door to the service, though attendance at them brings no obligation whatever.

We can be glad that we now have a democratic military policy that is working and that will save lives if war ever comes again.

COAST ARTILLERY BOARD NOTES

Communications relating to the development or improvement in methods or materiel for the Coast Artillery will be welcome from any member of the Corps or of the service at large. These communications, with models or drawings of devices proposed may be sent direct to the Coast Artillery Board, Fort Monroe, Virginia, and will receive careful consideration.—R. S. Abernethy, *Col., C. A. C., President Coast Artillery Board.*

New Projects Initiated During the Month of June

Project No. 239, Transits for Coast Artillery.—The Chief of Field Artillery and the Chief of Engineers recommended that in order to simplify production and to insure production in quantity during an emergency a standard transit be adopted for all branches of the service, the least reading on the horizontal scale to be one minute and the solar attachment to be eliminated. This recommendation was concurred in by the Coast Artillery Board.

Project No. 240, Subcaliber Mounting, Model 1924E, For 37-mm. Gun, Model 1916, on 155-mm. Gun, Model 1918.—A new mounting has been designed and constructed by the Ordnance Department and submitted to the Board for service test.

Project No. 241, Test of 3-Inch A. A. Guns, Models 1917-MI. 1920 and 1923E.—These three guns were recently exhibited at Aberdeen Proving Ground to representatives of the Coast Artillery. Many new features in carriage design and sighting apparatus were incorporated in these guns and some additional changes were recommended by the Board. Final study and test will be held later this year at Fort Monroe with a view to selecting the best guns and sighting systems for both mobile and fixed mounts.

Project No. 242, Communication System for Mobile Seacoast Artillery Units.—The communication system for mobile Coast Artillery units is being studied by the Board with a view to recommending changes in equipment tables to provide sufficient communication materiel for firing on moving naval targets.

Project No. 243, Fuze Setter for Antiaircraft Artillery.—In this connection reference is had to Project No. 155, published in Coast Artillery Board Notes, April, 1924, issue of The Coast Artillery Journal. The Board recommended that a new fuze setter be constructed, the support to be as described under Project No. 155.

The fuze setter proper should consist of a double fuze receptable, each one being similar to the Model 1916 setter. The two should be set by a common setting handle and scale convenient to the operator seated on the support. They should be inclined from each other (laterally) so that the two cannoneers in inserting and turning projectiles will be far enough to avoid interference. The circular guides on the proposed fuze setter should be farther from the fuze setter proper than in the case of the Model 1916 bracket fuze setter. It is believed that

the maximum rate of fire and most accurate dead time conditions will be permitted by the use of a fuze setter as described.

Project No. 244, Ordnance Equipment Chart For 155-mm. Gun Regiment.—The chart is being studied by the Board and by the 51st Artillery at Fort Eustis with a view to recommending any desirable or necessary changes.

Project No. 245, A Range and Azimuth Corrector Designed by Captain G. H. Ericson, C. A. C.—This device is exceedingly ingenious and does the work of a range board, deflection board and percentage corrector and includes a means of interpolating for corrected firing data every 15 seconds on the basis of a 30-second predicting interval. Captain Ericson has used this device successfully in firing 155-mm. guns at Fort Eustis.

Previous Projects on Which Work Has Been Accomplished

Project No. 193, Test of Radio Set SCR-132.—

1. The Chief Signal Officer requested that the SCR-132 set be given an intensive service test at Fort Monroe and that after 30 days operation a report be rendered on the set. The principal purpose of the test was to determine what modifications, if any, should be made in the SCR-132 before contracting for quantity production.

2. *a. The Radio Set,* SCR-132 is an undamped wave radio telegraph and telephone set to work with Army observation and night bombing planes. It was designed to have a range for telegraph of 200-250 miles, and for telephone of 80-100 miles. The transmitting frequency range is 353-157.9 kilocycles (850-1900 meters); the receiving frequency range is 600-100 kilocycles (500-3000 meters).

b. The Transmitter, BC-127, has a normal output to the antenna of 300 to 400 watts. It is designed to operate at the specified frequency (353-157.9 kilocycles) with antennae whose equivalent capacities lie between 1000 and 4000 micro-microfarads. The radio frequency circuits are of the master oscillator-power amplifier type, having a main and an intermediate power amplifier. The plate circuit of the main power amplifier is coupled to the antenna by means of an antenna transformer. The master oscillator and the intermediate power amplifier are VT-4 (50-watt) vacuum tubes; the main power amplifier is VT-22 (250-watt) tube. The modulation circuits consist of two speech amplifiers (VT-4's) connected in parallel and transformer-coupled to two speech modulator tubes (VT-22's) in parallel. The modulator tubes draw their plate supply in parallel with the plates of the main power amplifier tube through an iron core reactor. The transmitter provides three separate methods of communication, to-wit: (a) radio telephony, (b) undamped wave telegraphy, and (c) tone (modulated) telegraphy. In tone telegraphy a small motor alternator supplies audio energy to the input circuit of the speech amplifiers, producing a note of frequency between 500 and 800 cycles. A five-step rheostat, connected into the field circuit of the motor alternator, provides five different tones between the two limiting frequencies. A particular feature of this transmitter consists of provisions for remote control. The lines from a remote telegraph key or from a remote microphone can be attached to binding posts provided on the transmitter for this purpose. In operation of the transmitter by remote control an attendant is required at the transmitter to put it into operation and to supervise its adjustment.

c. The Power Equipment, GN-32, is a motor-generator set consisting of the following machines mounted on a single base:

1. A 2000-volt direct current generator.
2. A 110-volt direct current generator.
3. A 12-volt direct current generator.
4. A 110-volt or 220-volt alternating current single-phase induction motor.

The two low-voltage generators and the motor have a common shaft and a common housing. The high-voltage generator is direct-coupled to the motor shaft. The 2000-volt generator is provided with two 1000-volt commutators to provide 1000-volt current for the VT-4 tubes. The single-phase induction motor is provided with a split-phase winding for starting. This winding is short-circuited when the motor attains proper speed. The motor is constructed to operate on either 110-volt or 220-volt single-phase alternating current. The power equipment may be operated on 110-volt direct current by utilizing the 110-volt direct current generator as a motor.

d. The Control Panel, BD-44, contains a line switch, an AC-DC switch, a field switch, a field rheostat for the high-voltage generator and a direct current starting box. Two 100-ampere, 250-volt fuses are placed in the circuits between the line switch and the A. C.-D. C. switch.

e. The Receiver, 1420-C, is a thoroughly shielded, highly selective, coupled-circuit receiver. It has a frequency range of 1200 to 40 kilocycles (250-7500 meters) when used with an antenna whose capacity is .0009 mf. The antenna circuit is a series circuit comprising a coil, variable in six steps, and a continuously variable air condenser. The secondary is a parallel circuit comprising a coil, variable in six steps, and a continuously variable air condenser. Magnetic coupling between the antenna and secondary circuits is obtained by means of a coupling coil connected in series with the secondary coil and linked magnetically with the antenna loading coil. The coupling coil is ingeniously shielded to prevent capacity coupling between it and the antenna circuit from affecting the detector. A tickler coal coupling the plate circuit of the tube to the tuned grid circuit provides for oscillation. Near the tickler knob is a test push-button, which when depressed, short-circuits the tickler and stops oscillation. Attached to the inductance switches are a number of blades which short-circuit the high inductance sections of the coils when they are not in use. This prevents the unused sections from drawing much energy from the sections of the coils in use. A four-pole double-throw "anti-capacity" switch provides for connections for radio frequency amplification, for crystal detection, and for the vacuum tube detection. A test buzzer enables the antenna circuit and secondary circuit to be tuned to approximately the same frequency. A filament rheostat and filament ammeter provide for the adjustment of the filament current when a tube is used in the receiver.

f. The Amplifier, BC-118, is a radio-audio frequency amplifier using six VT-5 tubes. The frequency range of the amplifier is from 2404 to 10 kilocycles (125 to 30,000 meters), this range being covered in four steps. It consists of three stages of radio frequency amplification, a detector, and two stages of audio frequency amplification. The amplifier is shielded by being enclosed in a metal box. Three knobs on the front control the filament current, the wave-length taps on the radio frequency transformers, and the stabilizer, or potentiometer. A two-way switch provides for (1) radio-audio frequency amplification, and (2) detection and audio-frequency amplification. Two binding posts provide for an external tickler. A door on the top gives access to the tubes.

g. The Heterodyne, BC-104-A, has a frequency range from 600 to 100 kilocycles (500 to 3000 meters). It is calibrated on two scales; the "A" scale having a mark every 10 kilocycles between 100 and 250 kilocycles, and the "B" scale having a mark every 20 kilocycles between 260 and 600 kilocycles. A plate voltage of 40 volts is required for the tube. When a VT-1 tube is used, a 4-volt battery is required for the filament. When a VT-5 tube is used, only 2 volts are required for the filament. Five controls are situated on the panel. One knob, marked "coupling," controls the coupling between the antenna circuit and the heterodyne. Another knob, marked "Filament Control," has two positions, "On" and "Off," to close or open the filament circuit, making the heterodyne operative or inoperative. A two-position switch, marked "Scale A" and "Scale B," is provided for the two ranges covered by the variable condenser.

h. The characteristics of the antenna at W. U. F., Fort Monroe, Va., are as follows:

T-type, 4-wire, phospher bronze, 7 strands B&S No. 14, 346 feet long between steel masts 165 feet high. Counterpoise—6 wires, parallel, under antenna. Fundamental wave-length—720 meters.

Discussion: 3. The results of the long distance test carried out on February 23, 1924, indicate that the SCR-132 set has ample power to cover the transmission ranges, both telephone and telegraph, for which it was designed. The transmitter is steady in operation, is easily adjusted, and requires little attention.

4. Although, on the whole, the tests for radio telephone communication with airplanes did not produce results which, of themselves, would indicate that such communication can be carried on with planes 100 miles distant, the fault, if any, would appear to be in the plane receiving equipment rather than in the SCR-132. The SCR-134 was not available for sufficient time to give it a thorough test. It is not certain that in the one test of the SCR-134 in a plane the ignition shielding was properly adjusted. Furthermore, in that test, the short range attained, 45 miles, was due in a large measure to interference from ground stations. The flight was made toward Washington, D. C.

5. *Defects developed in the Transmitter BC-127 a.* Early in the test the grid coupling condenser (Type UG-1014) in the main power amplifier circuit broke down and rendered the set inoperative until the condenser could be replaced. A new condenser of the same type was obtained and installed and no further breakdowns were encountered during the test. It appears from the history of the development of the BC-127 that this same trouble has been encountered before with Type UG-1014 condensers.

b. Some two weeks after the SCR-132 had been in operation trouble was encountered in the Master Oscillator grid condenser, (C_1). When the set was being held in readiness for duplex operation on U. W. telegraphy during reception (power on and tubes lighted) this condenser would discharge at an audible frequency and with an intensity that interfered with reception. The frequency of the discharge could be lowered by increasing the value of the keying register (R_8) and the audibility could be eliminated entirely by doubling the value of R_8. It appears likely that this trouble was due to the development of a grid leak, probably from dust or moisture on the set.

c. The present method of connecting the tone generator into the filament circuit requires an undesirable amount of adjustment of filament current when the set is switched from U. W. telegraphy to tone telegraphy. It appears to be susceptible of considerable improvement. Furthermore, the lower frequencies of the tone alternator are believed to be too low. Most stations listening to the

tones reported that the highest was the best for reception. It is thought that the entire range of frequencies should be raised.

6. The tubes, coils and condensers, and the microphone, with which the set is equipped, appear to be satisfactory, with the exceptions noted in paragraph *5a*.

7. The performance of the power equipment was satisfactory throughout the test. Although it was kept running continuously, day after day, no defects developed and no adjustments were required.

8. The Control Panel, BD-44, is satisfactory. No defects developed in it during the test.

9. *Receiving Equipment.*—The Receiver, 1420-C, is well adapted to use with the SCR-132. With the tickler coil in operation and the receiver connected to a two-stage audio-frequency amplifier (such as the SCR-72) all the selectivity and amplification desirable is obtainable when receiving on an antenna. This method of operation obviates the necessity of a heterodyne. The Heterodyne, BC-104-A, is satisfactory for heterodyne reception, but such a method does not appear to be necessary when the 1420-C receiver is operated as described above. The Amplifier, BG-118, is a satisfactory unit only for loop reception, in which case radio frequency amplification is usually necessary. Such reception may be expected to be employed at the remote control station when the transmitter is operated from that station. The BC-118 is not suitable as an audio frequency amplifier alone. Such use of it requires the employment of a heterodyne, because the detector tube in the amplifier itself must be used, instead of the detector tube in the receiver, 1420-C, and this prevents the use of the tickler on the receiver.

10. The Board believes that this is an opportune time to discuss the suitability of the SCR-132 set for mobile artillery units. In 3d Ind., O. C. S. O., May 24, 1922 (413.44) to C. C. A., the Chief Signal Officer recommended that the SCR-132 set be assigned as follows:

In Motorized Artillery Units—One to BRIGADE HEADQUARTERS for communication with planes and army artillery.

In Railway Artillery Units—One to each BATTALION for communication with planes and regiments; one to each REGIMENT for communication with planes and brigade; one to each BRIGADE for communication with regiments, army artillery and planes.

The Board has been informed that the SCR-132 is intended also for permanent coast defense stations where telephone communication with aircraft over a distance greater than 30 miles may be necessary.

In addition to the equipment listed in paragraph 1, the SCR-132 set requires, for field use, a 5-kilowatt power plant. The total weight of the set, including the power plant, will be between 2000 and 2500 pounds. This is considerable impedimenta to add to the equipment of any mobile unit. Such an increase will probably not be a very serious matter for railway units, as the equipment, once emplaced in railway cars, would remain there permanently, but in the brigade headquarters of a motorized unit such an increase in equipment will necessitate an increase in the motor transportation of at least one truck, if not two. In any event, the 5-kilowatt power plant and the generator unit (GN-32) of the SCR-132 cannot be operated in the same truck with the transmitter and receiver, because of the noise of operation of the two power units. This same limitation applies to the use of the SCR-132 by railway units.

The Board believes that the need of any of the organizations listed in this paragraph for radio set having the power of telephone communication with air-

craft up to 100 miles is questionable, at least. Certainly for spotting purposes a set having a radio telephone range of communication with aircraft up to 30 miles is believed to be adequate. It is understood that such a set is under development by the Signal Corps. Furthermore, for radio net communication in the field, it is believed that neither a battalion, a regiment, nor a brigade, either of motorized or railway artillery, will require a range of operation anything like that of which the SCR-132 is capable. Certain coast defenses of major importance may well require a set of the power of the SCR-132.

11. It is to be noted that the foregoing remarks apply equally to antiaircraft artillery units.

If the SCR-132 set is to be issued to any motorized unit, it is believed that provisions should be made for a truck for the set. The 5-kilowatt set and the power equipment (GN-32) should be emplaced semi-permanently in the truck and space should be available for the other components of the set including spares and antenna equipment.

12. *Conclusions.*—The Board is of the opinion that the radio set SCR-132 has the power for which it was designed and that, with the exceptions noted in paragraph 5, no serious defects exist in the set.

13. *Recommendations.*—The Board recommended:

a. That a more dependable type of condenser than the UC-1014 be sought for the transmitter.

b. That the method of connecting the motor alternator into the filament circuits be studied with a view to arriving at some method which will require fewer adjustments when the set is to be switched from U. W. telegraphy to tone telegraphy.

c. That consideration be given to raising the frequency range of the five tones of the motor alternator.

d. That, in view of the remarks in paragraph 10, the proposed assignment of the SCR-132 set be reconsidered.

e. That consideration be given to the adoption of a suitable truck for the SCR-132 for issue to motorized units which are to be supplied with the SCR-132 set.

BULLETIN BOARD

Battery B, 61st Coast Artillery, Fires at Sleeve Targets

By Captain C. W. Higgins, C. A. C.

Due to heavy shipping and limited field of fire the conditions for antiaircraft artillery firing at a sleeve target towed by an airplane are not satisfactory at Fort Monroe, Va. An ideal battery site, located at Grand View, Va., has been used during the past year.

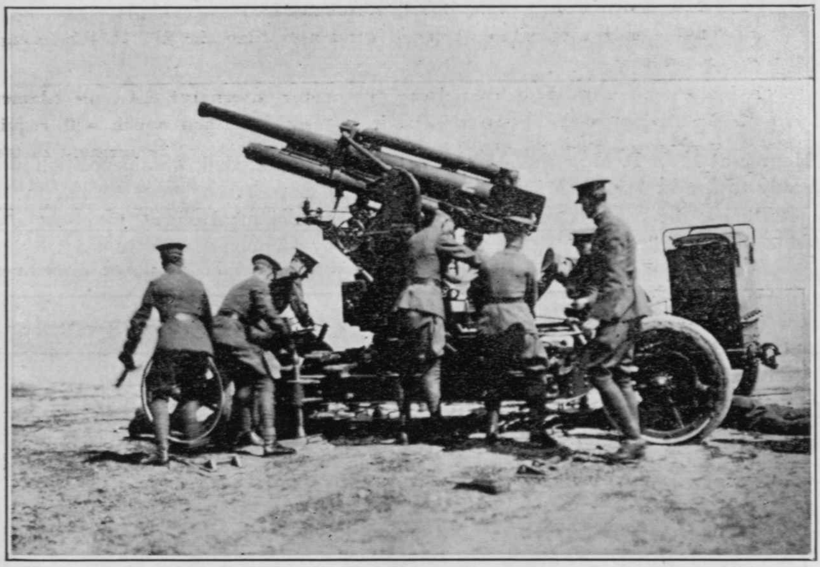


Fig. No. 1

Grand View is an undeveloped resort situated on the Chesapeake Bay five and one-half miles north of Fort Monroe via the beach and eight miles by road. The gun battery can be emplaced practically on the shore line and a field of fire of 150 degrees obtained.

Light conditions are more favorable in the afternoon and with the exception of a few occasions all firings have been conducted in the afternoon.

The battery usually leaves Fort Monroe at 12:30 P. M. and is waiting in position when the airplane towing the sleeve target is due on its course about 2:00 P. M. A record run was made on April 22, 1924, when the battery left Fort

FIG No. 2

Monroe at 12:35 P. M., covered eight miles over a shell road, was in position and ready to fire at 1:35 P. M.

During the past six months the battery has conducted eleven practices and demonstration firings at sleeve targets towed by airplanes, at altitudes varying

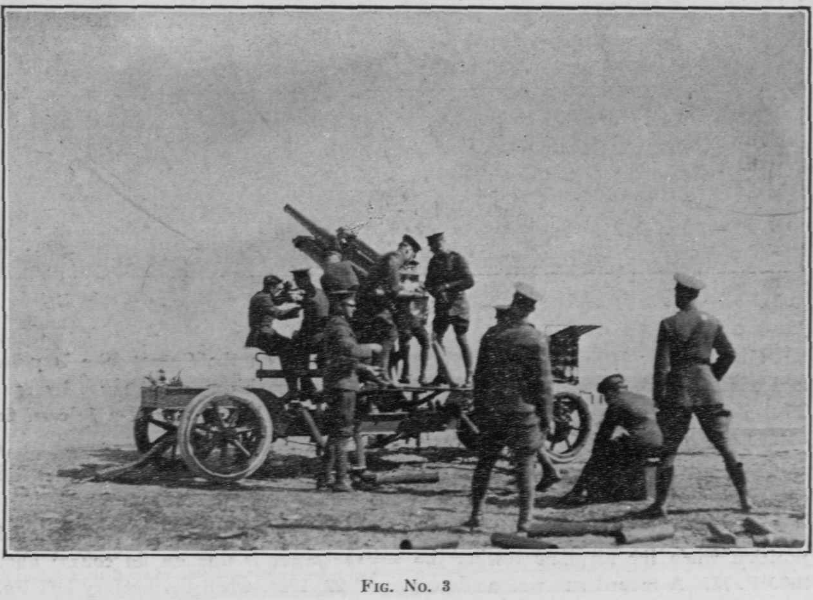


FIG. No. 3

Fig. No. 4

from 3000 to 5500 feet and horizontal ranges varying from 2000 to 4500 yards. During these firings 273 rounds have been expended which resulted in four direct hits having been obtained.

The following pictures were taken of the battery in action at Grand View, April 8, 1924, during a demonstration firing for the Field Officers' Class at a sleeve target.

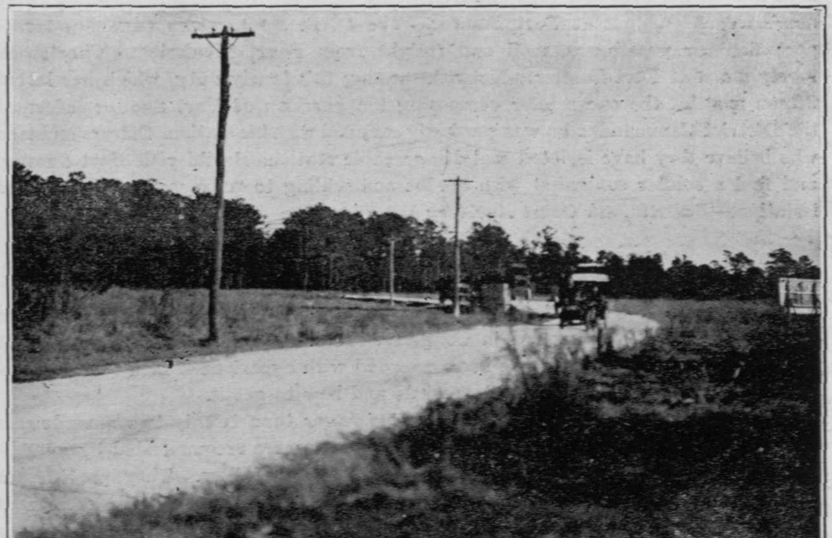


Fig. No 5

Figure 1 shows No. 1 gun being emplaced. The gunners are in the process of lifting the weight of the mount from the wheels with the four screw jacks, and a mechanic is seen filling the recoil cylinder.

Figure 2 shows No. 2 gun firing at the towed target. The loader is seen inserting a round into the chamber. One of the ammunition details is in the process of cutting a fuse while the other ammunition detail (on the extreme right) is securing a new round from the ammunition pile. A safety officer is seen in rear of the piece observing over the metal line of the gun. He ceases the fire of his piece should the deflection become greater than two-thirds of the length of the tow line.

Figure 3 shows similar operation of No. 2 gun. The breech operator has just opened the breech and the empty case is seen falling from the chamber in front of the breech operator's right leg. The relayer has just delivered a new round to the loader who is ready to insert it into the chamber.

Figure 4 shows two guns in operation. The gun on the left is in recoil. The gun on the right has just been loaded and ready to fire. The airplane towing the target is seen in the upper right hand corner of the picture. Note the flow of ammunition from the piles to the guns.

Figure 5 shows the battery convoy returning to Fort Monroe over the shell road which crosses the marshes between Grand View and Fox Hill after the practice.

An Example of Optimism

Brigadier General William H. Johnston, commanding the Fourth Coast Artillery District, while inspecting Fort Sumter, found the garrison consists of one private, 170th Company, C. A. C. The two 12-inch guns of its armament are out of commission. Breech blocks and all instruments for plotting room being stored at Fort Moultrie. This one soldier is able to visit Fort Moultrie only once each month, his wife and four children living at Moultrieville, but spending three months each summer at Fort Sumter. The D. B. Boat, which furnishes transportation for passengers, mail and freight from Fourt Moultrie to Charleston, rarely stops at Fort Sumter. Notwithstanding this lonely duty, which has lasted fifteen months, the one soldier composing the garrison of Fort Sumter informed the District Commander he was perfectly satisfied with his station. Officers and men who believe they have isolated and disagreeable stations should visit Fort Sumter, and find a soldier contented with his lot and willing to "carry on" regardless of isolation.—*Bulletin, 4th Coast Artillery District.*

Join the Illinois National Guard

Since the war the National Guard has had better treatment. It is no longer anybody's dog to kick around in Congress. It showed its stuff in the war. It went in green enough, but came back crowded with experienced men and organizers. The new Guard knows what it needs and how to get it.

The Congress just adjourned passed no fewer than twenty-two amendments to laws affecting the National Guard. All of them were recommended by guardsmen. In general, they will give the Guard more flexibility. They provide for more sergeant-instructors from the Regular Army, for more flexible enlistment periods, for pay by the drill regardless of the total number of drills attended, for longevity pay, and for other details technical but important to National Guard efficiency. Congress is getting good to the National Guard.

Will the general public have the same attitude? There is every reason to expect it. So long as the Guard is kept out of partisan industrial disputes, and trained only in the interest of the general public, there is no danger for its popularity. It is the backbone, or at least the abdominal cavity, of our popular defense. It is a trained reserve that is kept training, and that is essential to the American defensive system.

An enlistment in the Guard is good for a young man and an experience that he will be glad to remember. Rookies, or others not so rookie, should not hesitate to "join up." Fifteen hundred are needed.—*The Chicago Tribune.*

What Tank School Thinks of "Military Motor Transportation"

Tank Notes, an excellent periodical published in mimeograph form at Camp Meade, Maryland, for the dissemination of tank information, and edited by Major A. C. Cron, Infantry (Tanks), has the following to say: "The 1923 edition of 'Military Motor Transportation' has recently come from the press of the Coast Artillery Journal, Fort Monroe, Va. This excellent publication has been adopted as a text book in the Tank School Correspondence Course and will also be used as a reference book in the regular courses this year. It sells for $1.25 and should form a part of the professional library of every army officer."

Thompson Autorifle is Delivered to Army

The first five of the new Thompson autorifles out of the total of twenty which the Auto-Ordnance Corporation of New York is under contract with the Ordnance Department, U. S. A., to deliver during the coming year, were formally turned over to the commanding officer of Springfield Armory on February 1.

These rifles are of the semi-automatic shoulder rifle type, firing service caliber .30 high-powered cartridges. Each rifle has a total of seventy-six component parts, 30 per cent of which are identical with the U. S. Springfield rifle, model 1906. They can be used for either semi-automatic fire, i.e., a shot for each pull of the trigger, or in the same manner as the present hard-loaded Springfield rifle.

The magazines are of a new type of either five or ten cartridge capacity. They may be loaded either attached to or detached from the rifle. When attached to the rifle the method of loading is identical with that of the present Springfield rifle. The rate of fire of forty aimed shots per minute is practicable with the new arm.—*Army and Navy Journal.*

Pay and Allowance of Reserve Officers

A Reserve Officer when on active duty shall receive the pay and allowances as prescribed, and mileage to his first station from place of receipt by him of his order and from his last station to his home.

The base pay of the different grades per month are as follows:

For Colonel, the 6th pay period or $333.33.

For Lieut. Col., the 5th pay period or $291.67.

For Major, the 4th pay period or $250.00.

For Captain, the 3rd pay period or $200.00.

For 1st Lieut., the 2nd pay period or $166.67.

For 2nd Lieut., the 1st pay period or $125.00.

The increase of pay for each three years' service is 5 per cent of the base pay. In computing this, Reserve Officers shall be credited with full time for all periods

during which they held commissions in the army on active duty and one-half time for all other periods during which they held reserve commissions and not on active duty.

The pay status begins on the date that the officer officially complies with the order calling him to active duty and ends when he is relieved from active duty.

In addition to the base pay, reserve officers will be entitled to subsistence allowances per month as follows: Those of the 1st pay period, one subsistence allowance, or $18.00; those of the 2nd, 3rd and 6th pay periods, two subsistence allowances, or $36.00; those of the 4th and 5th pay periods three subsistence allowances, or $54.00; provided that an officer with no dependents shall receive only one subsistence allowance.

Under no condition is a reserve officer entitled to rental allowances if furnished personal shelter or quarters, even though no quarters are furnished for his dependents and none are available. However, there is legislation now pending which, if enacted, it is hoped will remedy this condition.

The law allows mileage at the rate of 4c per mile to reserve officers attending camps for a period of 15 days or less, and from this amount there must be deducted 3c per mile when transportation requests are not used for that portion of the travel which is over land-grant or bond-aided railroads, and for any travel for which transportation requests are furnished. Therefore, all officers are urged to make request for government transportation request to and from camp. Reserve officers ordered to active duty for more than 15 days will receive 8c per mile to and from camp.

Payment for mileage to and from camp may be paid before the officer leaves camp for home.

Methods and Purposes of the C. M. T. C.

Brigadier General William H. Johnston, U. S. A., has issued a statement defining the methods and purposes of the C. M. T. C., in which he says:

"Section 47d, of the National Defense Act, as amended by Congress, June 4, 1920, authorizes the Secretary of War to maintain upon military reservations or elsewhere schools or camps for the military instruction and training of such citizens as may be selected upon their application for attendance at such schools or camps.

"Each year, the number of young citizens, 17 to 24 years of age, who may be sent at government expense to these schools depends upon the funds appropriated by Congress. In 1923, approximately 24,500 were trained. In 1924, the Budget estimates are sufficient to train 28,000. To obtain this number, it is probable that 25,000 applications will be accepted, and 40,000 applicants are desired.

"In his first year's instruction, a C. M. T. C. candidate is given basic instruction in Infantry, and called a Basic. For his second year, a candidate may choose instruction for Coast Artillery, Field Artillery, Cavalry, Infantry, Corps of Engineers, Signal Corps, etc. He is then in the Red Course, being called a Red. His third year must be taken in the branch of service chosen the second year, but his course is higher and he is called a White. In his fourth and last year he pursues the study of the same branch of the service, and is called a Blue. Successful completion of this Blue Course and passage of examination at its close entitles the candidate to certificate of eligibility for a commission as 2nd Lieutenant, Officers' Reserve Corps, in the branch of service which he selected for his instruction. When 21 years of age, this certificate may be exchanged for a commission in the Organized Reserves.

"During these four sessions of summer school in camp, candidate incurs no expense; he pays no tuition. The government pays him five cents a mile for travel to and from the place of training, shelters him under canvas tents or in barracks, loans to him uniform clothing, bedding, equipment, arms, etc., precisely the same as are furnished soldiers in the Regular Army, feeds him as well as first-class hotels, furnishes medical and dental treatment in emergency cases, provides service clubs, excursions to places of interest, dances, moving pictures, athletic games, field meets, prizes for excellence in each, and finally, moral and religious influence of non-sectarian nature.

"The real objective is not only to produce potential soldiers for the future, but actual good citizens for the present. In its conduct of these summer schools, the Army of the United States acts, not as an engine of destruction, but as a power plant generating good citizenship throughout the country; the greatest constructive agent yet developed under our laws for promotion of the general welfare of the people of the United States.

"If nothing more were obtained than mutual acquaintance and association of young men from all walks of life, from various parts of each state and from several states, much would be accomplished to break down the barriers existing between men of the farm and men of factories, with generations of American ancestors and other more recently naturalized and accepted as citizens.

"Success in life in any vocation demands confidence in one's self. Pride of country, as well as community, resolution to do one's best in competition with others, ad faith in one's ultimate success; all these virtues of good citizenship are taught at these schools and camps."

Since any state worthy of permanent respect in the world must be composed of worthy citizens, the main objective of this summer training is to provide for this country a sufficient number of self-respecting, resolute citizens. When this objective has been gained, our country will possess a sufficient number of the kind of citizens essential to its permanent existence. Therefore the initials at the head of this article, C. M. T. C., may unofficially be interpreted as meaning, "Citizens Make Their Country."

The 607th Coast Artillery

EDITOR'S NOTE: THE JOURNAL *is in receipt of a letter from the Adjutant of the 607th, Coast Artillery, the subject matter of which follows:*

The 607th Regiment Coast Artillery, 2nd Coast Artillery District, has been ordered to Fort Hancock for active training from August 1st to 15th with the Citizens' Military Training Camp to serve as instructors at the camp. This is in accord with the plans of the War Department for linking up the C. M. T. C. students and the O. R. Corps, to further their plans and to tie up the work from year to year. The officers of the 607th Regiment have announced that they will present to the honor student of the camp a medal with the Regimental coat of arms thereon and in addition, to each student that graduates from his course and who enlists in the 607th, a set of the Regimental insignia will be presented, with proper ceremony.

Each of these students now enlisted in the Regiment will then be enrolled in the Army Correspondence Course for next winter's work and to assist him in this work, classes will be conducted by officers of the Regiment a certain number of evenings each month where their correspondence course work will be explained and made comprehensible to them. The Regiment is endeavoring to secure a

complete equipment of its own armament so that practical work can be done with these students.

A number of the officers of the Regiment have announced that they will offer suitable prizes to those students who excel in their work during the winter classes.

These plans are sent you, as we believe them to be the first effort made by any Reserve Regiment to definitely link up the C. M. T. C. students with the Organized Reserve Regiment and also to continue the work of the summer training throughout the winter and thus insure the enrollment of a large number of graduates from one course for the next course the following year, as well as giving the young men a more tangible idea that they are a part of a live organization, which occupies a definite position in the defense of our country. Believing that some such plans could be followed out in other parts of the country, we are sending them to you for publication, if in your judgment these ideas are worthy of being presented to the Coast Artillery service as a whole.

Our Regiment only wishes to pass these ideas on to those who desire to use them.

Coast Artillery Board Changes

The following officers have been relieved recently from duty with the Board and assigned as follows:

Colonel H. J. Hatch, C. A. C., to Army War College.
Major J. B. Gillespie, Ordnance Department to office Chief of Militia Bureau.
1st Lieut. L. W. Jefferson, C. A. C., to 12th Regiment, Fort Monroe.

The membership of the Coast Artillery Board as of August 15 is as follows:

Colonel R. S. Abernethy, C. A. C., President.
Major R. Donovan, C. A. C.
Major R. R. Welshmer, C. A. C.
Captain B. F. Harmon, C. A. C.
Captain J. F. Stiley, C. A. C.
2d Lieut. P. Schwartz, Ordnance Department.

PROFESSIONAL NOTES

Present Status of Training Regulations

By Colonel W. E. Cole, C. A. C.

In 1921 the War Department adopted the policy of publishing all drill regulations and memoranda connected therewith in the form of training regulations. Each chief of branch is charged with the duty of preparing the particular regulations that pertain to his branch. After their preparation by the chief of branch they are approved by the General Staff and then published under direction of the Adjutant General. In some cases chiefs of branches have appointed boards of officers for the purpose of preparing training regulations for which they are responsible. The Chief of Coast Artillery placed this duty upon the Commanding Officer, Coast Artillery Training Center, and when the latter title lapsed the duty fell upon the Commanding General, Third Coast Artillery District, who at the present time is, as you know, also Commandant of the Coast Artillery School. After the preparation of training regulations under the direction of the Commanding General, Third Coast Artillery District, they are submitted to the Chief of Coast Artillery, who causes them to be revised, if necessary, and submits them to the War Department for approval and publication.

Training regulations are prepared with a view to their publication quickly and in large quantities in case of war, and are so written that only those required by an officer need be supplied him. The policy is to assume that in war time a lieutenant will have only the training regulations that he requires. The captain will require certain regulations for himself as well as all that are required by the lieutenant; and similarly, the coast defense commander will have at his disposal all the training regulations required by his subordinates, and in addition, T. R. 435-300 "The Coast Defense Command." This restricted distribution does not apply in peace time.

Training Regulations 435-55, "Analysis of Drill and Analysis of Reports of Target Practice," was one of the first prepared under the direction of the Chief of Coast Artillery. This training regulation had previously been published as C. A. M. No. 3. It treats of analysis of drill and target practice, and is, I believe, one of our most important ones. By carefully adhering to its provisions the captain of a battery should be able to determine the personnel errors incident to the drill and the individuals responsible for them. He should, therefore, so arrange the manning detail of his battery that the individual soldiers can perform the duties that devolve upon them with accuracy, thereby insuring the best results possible during target practice or in action. In the analysis of actual firings the resultant errors, due to the various sections, are shown and the armament errors also can be determined.

The training regulations for the harbor defenses, including the service of the piece for each type of armament, "The Battery Command," "Fire Control and

Position Finding," "The Fire Command," "The Fort Command," and "The Coast Defense Command" have been prepared. There will be training regulations published on tactical employment of searchlights and emplacement and tactical employment of Coast Artillery in harbor defense. These training regulations embrace the major part of the Coast Artillery Drill Regulations as published in 1909 and later amended and published in 1914 and 1917. The training regulations for antiaircraft artillery from the battery up to and including the regiment, have been published or are about to be published; those on railway artillery and other pertinent subjects are in course of preparation. The training regulations prepared under the direction of the Chief of Coast Artillery should be sufficiently comprehensive to enable Coast Artillery commanders to train their commands insofar as pertains to strictly Coast Artillery training. If this is found not to be the case it will be necessary to supplement them with certain manuals, but that is for the future; no action has been taken looking to the preparation of such manuals insofar as the Coast Artillery is concerned.

There are many training regulations published by other branches and departments of the service that are necessary for the instruction of Coast Artillery troops. They will be supplied to all officers of the army who require them. It may be advisable to publish a list of all training regulations required by a Coast Artillery officer, but this had better be done when their preparation is a little farther advanced than it is at present.

In order to keep the training regulations up to date, the War Department will make necessary changes yearly. It is, therefore, incumbent upon an officer to submit recommendations looking to the improvement of training regulations whenever his experience demonstrates that changes are desirable.

Target Practice of the 55th Coast Artillery

By MAJOR F. A. MOUNTFORD, C. A. C.

The record target practices of the Second Battalion, 55th Coast Artillery, were held in the vicinity of Nankuli on the west shore of the Island of Oahu. These practices were preceded and followed by a march of about 35 miles from Fort Ruger to the gun positions and return. The light column preceded the heavy column and marched during the day of March 31st. The heavy column marched at night, leaving Fort Ruger at 8:00 p. m., March 31st. A marked improvement was noted in the marching of the heavy column over that of previous years. It is believed that this was due to the policy of holding night marches twice each month during the artillery training period.

There were no spare 10-ton tractors and only two 5-ton tractors in the battalion. Battery "E", which had the least mechanical trouble, completed the outward trip of 35 miles in a total elapsed time of 13.5 hours. The return trip was completed in 14 hours, with an average rate of march for the 70 miles of 2.6 miles per hour. On the outward march the battalion made the first 27 miles, before a halt of one and one-half hours was made for breakfast, in 10 hours with an average rate of march of 2.7 miles per hour. On the return march about three miles of dirt canefield road was a quagmire of gumbo mud two feet in depth in many places. Battery "E", after passing this obstacle, made the last 25 miles to Fort Ruger in seven hours, an average rate of march of 3.6 miles per hour.

In considering the above rates of march it should be noted that: (a) no spare tractors were available, which necessitated a halt of the entire battery when

mechanical trouble developed in one tractor; (b) the march was made at night on slippery metaled surface roads over many treacherous hills; (c) that march discipline was maintained at all times; and (d) that total elapsed time, and not running time, was used in the computation.

In no branch of training is the axiom "Practice Makes Perfect" so applicable. In order that the maximum mobility of a 155-mm. gun battery may be realized frequent marches must be held. These marches are essential of course for inexperienced tractor drivers. They are invaluable to the experienced tractor drivers in order that they may maintain their skill. But they are most valuable of all to the tractors themselves which cannot be relied upon otherwise.

The target practices were held in the competition in the Hawaiian Coast Artillery District for a cup, to be awarded to the battery holding the best day and night practices, by the Commanding General, Hawaiian Department. The object was to obtain the maximum number of hits per gun per minute on the competition target, at maximum searchlight range (assumed to be 10,000 yards) for the night practices, and at the maximum range of the armament for the day practices. The competition target is a rectangle with its longer axis perpendicular to the gun-target line at all times. The dimensions of this target are one probable error in range and 208 yards in direction, the towed target being at the center of the rectangle. The formula for the determination of the figure of merit takes into consideration the number of hits, the number of shots, the probability of hitting, the time of the series as compared with a constant for each type of gun, and the average range at which the practice was fired as compared with eight-tenths of the maximum range for day practices and eight-tenths of the maximum searchlight range (10,000 yards) for night practices.

The twelve guns of the battalion were placed in position on the beach. The selection of this position close to the shore line was governed by the safety conditions incident to the target practices. A horizontal baseline 7600 yards in length with two elevated O. P.'s, was used. The lateral deviations were observed from the battalion commander's elevated station approximately on the gun-target line. The pyramidal target was towed by the tug Cuba at the usual speed. In the day practices, due to the extreme range, the target was not visible from the guns. The towing vessel was hull down and no splashes could be seen from the guns. Not a shot was fired during the practices which was considered to have an excessive lateral deviation or which endangered the towing vessel.

At night the target was efficiently illuminated by four 36-inch Cadillac Searchlight Units manned by Battery "E", 64th Coast Artillery. Four 36-inch Mack Searchlight Units were used for barrier safety lights.

The following table indicates the results obtained in the three days and three night practices:

Organization	*Day or Night*	*Mean Range*	*Total Time Min.*	*No. of Shots*	*No. of Hits*	*Hits per gun per minute*
Battery F	Day	15,600	4.0	30	8	.500
Battery F	Night	8,760	4.0	26	2	.125
Battery E	Day	16,600	4.5	31	4	.222
Battery E	Night	8,600	2.5	19	5	.500
Battery D	Day	14,585	6.0	32	9	.375
Battery D	Night	9,860	3.5	23	7	.500
2nd Bn.	Day	15,661	14.5	93	21	.360
2nd Bn.	Night	9,040	10.	68	14	.350
2nd Bn.	Day & Night	12,350	24.5	161	35	.360

Fig 1

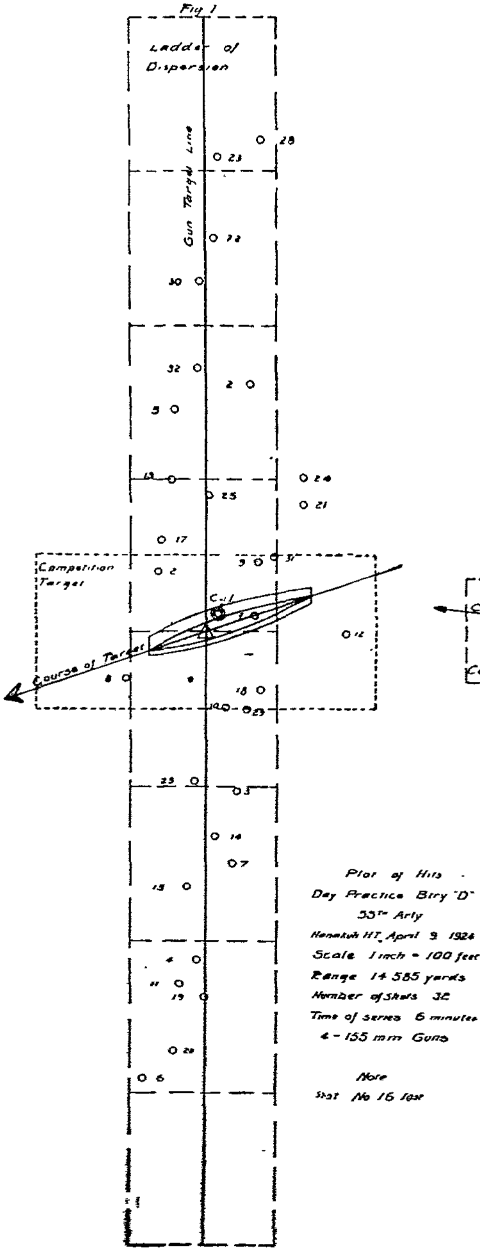
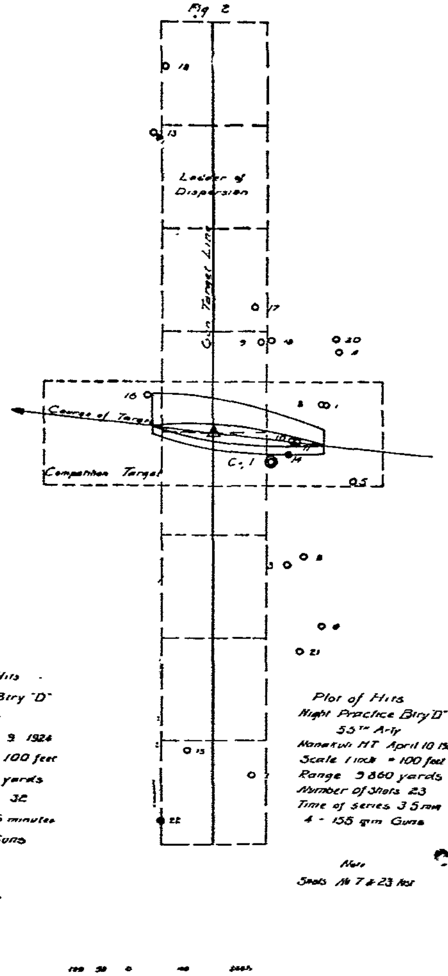

Ladder of Dispersion
Gun Target Line
Competition Target
Course of Target
Plot of Hits
Day Practice Btry "D"
55th Arty
Scale 1 inch = 100 feet
Range 14 585 yards
Number of Shots 32
Time of series 6 minutes
4 - 155 mm Guns
Note
Shot No 16 lost

Fig 2


Ladder of Dispersion
Gun Target Line
Course of Target
Competition Target
Plot of Hits
Night Practice Btry "D"
55th Arty
Scale 1 inch = 100 feet
Range 3 860 yards
Number of Shots 23
4 - 155 mm Guns
Note
Shots No 7 & 23 lost

The probability of hitting the competition target, with the center of impact on the target at all times was 25 per cent. A total of 35 hits out of 160 shots was obtained. This gives a percentage of hits of 22. Ten hits were obtained on the destroyer target, with a percentage of hits of 7. The average probability of hitting the destroyer target was 8 per cent.

Plots of the hits of the Battery "D" day and night practices with reference to the competition and destroyer targets are shown in the accompanying figure. In the day practice 9 hits were obtained on the competition target out of 32 shots, at an average range of 14,585 yards, in a total time of six minutes. The rate of fire, in hits per gun per minute, was .375. Twenty-eight per cent of hits was obtained as compared with the probability of 25. In this same practice one hit was obtained on the destroyer target, with a percentage of hits of 3, as compared with the probability of 4 per cent.

In the night practice 7 hits were obtained on the competition target out of 23 shots, at an average range of 9860 yards, in three and one-half minutes total time. The rate of fire, in hits per gun per minute was .500. Thirty per cent of hits was obtained as compared with the probable percentage of about 25. In this practice three hits were obtained on the destroyer target which gives a percentage of hits of 13, as compared to the probable percentage of 10 per cent.

In the day practice it is to be noted that there were 15 "overs," 15 "shorts" and 1 "target" out of 31 plotted shots. In the night practice there were 10 "overs," 9 "shorts" and 2 "targets" out of 21 plotted shots.

Battery "D," 55th Coast Artillery was commanded by 1st Lieutenant George M. Badger, with 1st Lieutenant Harold P. Hennessy, 55th Coast Artillery as range officer.

The aerial spotting by an observer and pilot from the 4th Observation Squadron, Wheeler Field, H. T., was very satisfactory. It is believed that this was due to the simplicity of the method used. When the plane was over the target one-way radio telegraph only was used. The messages from the plane were not repeated back or acknowledged from the shore. The observer indicated the number of overs and shorts in each salvo by sending: OOO—four over more than 200 yards; OO—four over within 200 yards; MO—three over and one short; CC—two over and two short; MS—three short and one over; SS—four short within 200 yards; SSS—four short more than 200 yards. The amount of the deviation and the lateral deviation were omitted. The latter is not accurate from the plane, can be obtained more accurately from shore and slows up the observation. The observer continues to send for example, MO, MO, MO, until he sees the next salvo land, when he sends a long dash followed by the new sensing. The radio truck was about one and one-half miles from the plotting room. A Magnavox with storage battery at the plotting room was bridged across the receiving circuit. A radio operator received the sensings in about 10 seconds after the fall of the shots, about the time required for fast work with the bilateral terrestrial observation. Aerial spotting to be of use to a rapid fire battery must be at least this rapid.

The method of fire adjustment for all practices—the trial shot method for trial fire and the bracketing method for improvement fire and fire for effect—is believed to be excellent. In improvement fire and fire for effect the battery commander applied the corrections necessary, by the bracketing method, to equalize the overs and shorts. After seeing the results of these practices I believe that it

would be advisable to prescribe that trial shots be fired prior to all target practices and service firings, with all types of armament as was the procedure prior to the World War.

During the target practices the battalion established its tents immediately in rear of the guns in the permanent camp named "Camp Hayden" under the command of the regimental commander.

The target practices were witnessed by many officers including Major General Charles P. Summerall, the Department Commander, Brigadier General John D. Barrette, Commanding the Hawaiian Coast Artillery District, Colonel Lawrence Brown, C. A. C., Commanding the Coast Defenses of Honolulu, Colonel Henry M. Merriam, 55th Coast Artillery, Regimental Commander, and Major Walter K. Wilson, C. A. C.

Spotting

By CAPTAIN A. M. JACKSON, C. A. C.

Spotting is not, as frequently supposed, the panacea for all the ills incident to the lack of proper preparation of fire. Ballistic data as now furnished the service is the fruit of many years' experience and is founded on unassailable natural laws and empirical formulae derived from profound study and experimentation. Is it reasonable to suppose, as some seem to have done, that the results obtained by the utilization of these laws and formulae can be equalled by the employment of this magic cure-all, the spotting board, used in conjunction with certain methods of "adjustment," based on the laws of probabilities? Proving ground experience convinces us that a gun shoots where it is pointed and will, in the long run, hit what it is aimed at with a well defined frequency. Will spotting give us more hits?

Is the function of spotting to tell us how far we missed the target or why we missed it? Obviously it has but the former function and the mistake lies in attributing to the spotting board the power of divining the answer to the latter question. The proper function, then, of spotting is to indicate whether or not fire has been correctly prepared. The deviations reported by a spotting system or may not be of value to the battery commander in determining what his preparation lacks of being correct. For rapid fire batteries, the sense of the shots should be sufficient, whereas for major caliber armament, both the sense and magnitude of the deviations should be determined. Whether or not this information is of value is determined by the amount of ammunition available for the shot. In the case of major caliber armament, the present target practice ammunition allowance is not thought to be sufficient for determining this point. Whether or not a knowledge of the amount of deviation would be of value to the battery commander during an engagement (providing the same were available) is a question of opinion. It is highly probable that if such information ever did reach the battery, it would be ignored in favor of more pressing questions.

Granting, then, that spotting has its important, though limited function, and that for the sake of argument we desire to know the magnitude of the deviations, there appear to be two methods of calculating the deviation. One method is to measure the observed deviation of the fall of the shot with respect to the target and then by computing the displacement of the setforward point from the position of the target at the instant of fall, we finally arrive at the deviation of the shot from its goal, the setforward point. The other method appears to be less round-

about and consists in measuring directly the deviation of the splash from the setforward point, thereby indicating how far the gun failed in hitting what it was pointed at. This latter method would appear also to have the advantage of speed, and it also draws the distinction between position finding and fire adjustment (preparation), in that it gives the deviation of the shot from the setforward point irrespective of whether or not that point was correctly predicted.

The next question that presents itself is that of determining who should supervise the work of the spotting detail and interpret its reports. In conformity with the argument that spotting is, in the final analysis, only a means of checking the accuracy of the ballistic corrections, it would appear that the spotting detail should form an integral part of the range section and that the range officer should be charged with the interpretation of its reports. The spotting device should be located in or adjacent to the plotting room so that the range officer can keep in close touch with it, without necessitating telephones.

Observation of fire is at present accomplished from terrestrial and aerial stations. The latter category comprises both heavier-than-air and lighter-than-air ships.

Aerial observation of fire, no matter how successful it has been, is, or may be, presupposes supremacy of the air, if only temporary. Joint Coast Artillery and Air Service practices have been many, and with marked success. The Air Service observers have demonstrated that they can spot the fall of a shot with an uncanny degree of accuracy. Why not let it go at that, admit that the thing can be done, and then turn our minds to methods for improving the preparation of fire, storing our Air Service knowledge away in the back part of our mind for that possible, the improbable emergency? Will a battle fleet attempt to engage shore batteries unless it has aerial supremacy for the moment? If it has no plans of its own, will our airplanes be able to spot for the Coast Artillery from beyond the range of the enemy antiaircraft batteries? If our planes can possibly do this, will they be able to transmit their intelligence to shore batteries, considering the impracticability of visual signalling and the probability of the jamming of radio communication?

If our forces do have aerial supremacy, why worry about spotting, or in fact about anything else, if we are to credit the claims of certain persons who are still convinced that the bombing tests off the Virginia Capes have spelled the doom of land fortifications?

The Coast Artillery was getting hits long before the army possessed an airplane. Our means of fire control have not apparently kept apace of the development of long range cannon. We can now, roughly speaking, shoot farther than we can see. In the light of past experience, this is a temporary condition that will be corrected solely by the ingenuity of the Coast Artillery. We cannot afford to depend for our vision on another service whose assistance under battle conditions is problematic. If we place our dependence on airplanes alone, they will probably fail us at the critical moment. We are drifting into dangerous doctrine when we assert, as some have done, that the Coast Artillery's future efficiency depends upon its ability to cooperate with the Air Service for regulation of fire. This is no more true than the assumption that the Air Service is dependent on the Coast Artillery.

Terrestrial observation of fire seems for the time being the only means of spotting that will be met with under battle conditions, and while some of us may chafe at the idea of not being able to see as far as we can shoot, our discouragement should be alleviated by the consolation that we are no worse off than the other fellow, but are in fact several shades better off in all departments of the game.

Character of Next War

Col. J. F. C. Fuller, author of "Tanks in the Great War," delivered an address recently in London in which he discussed the theory that future wars would be more mechanical than any war up to this time has been, and indicated a belief that infantry fighting in the old sense has become a thing of the past. Instead of relatively stationary lines of men, he visioned a moving line of slow tanks, aided by swift tanks to take the place of cavalry; tanks carrying mounted guns as a substitute for horsedrawn field artillery, fleets of tanks built to act as tank destroyers and still other tanks to serve as troop transports and supply vehicles. In that kind of war, Colonel Fuller sees the mere foot soldier reduced to the status of a military policeman following behind to occupy conquered territory and doing actual fighting only in country absolutely impracticable for tanks.

Some of the experiences of the last war seem to support this guess at what the next war will be, and there is reason for thinking that if the tank had been a little more intelligently handled when it was first sprung upon the Germans, its showing would have been still more impressive than it was; but when all allowance is made for the possible effect upon the next war of the innovations developed in the last, the great lesson of that struggle still seems to be that nobody really knows what will happen next. After the first onrush in 1914, the whole story of the great war became different from the expectation on either side. Trench warfare, which dominated the operations for three years, upset all of the calculations of the military prophets. Gas was an utter surprise, and the tanks when they appeared were an unprecedented novelty. It was not what everybody knew about war which characterized the fighting, but what had been kept secret, what was discovered, and, perhaps still more effectively, what blind fortune dictated. Had a military genius appeared in the World War, soldiers might now be studying lessons quite distinct from those which were evolved by the more or less talented commanders who gave character to it, and the conduct of the next war is likely to be evolved directly from the last, only in case the same kind of men command. —*Detroit Free Press.*

A Camera for Studying Projectiles in Flight

With very rapidly moving objects it is not possible to take a clear picture on a stationary film, since in the interval during which the film is exposed, the image of the object moves sufficiently to blur the picture. The present camera overcomes this difficulty by causing the film to move with approximately the same velocity as does the image of the object. Hence there is no blurring of the picture.

In order to secure a number of pictures, several lenses are placed at right angles to the direction of motion of the film and a focal plane shutter so arranged that the images from these lenses are allowed to fall on the film in succession. This gives a series of pictures of a stationary object which lie diagonally across the film. However, if the velocity of the image is the same as the velocity of the film, the pictures of the moving object will lie across the film perpendicular to the direction of motion.

The velocity of the object can be determined from the velocity of the image if the magnification of the lenses is known. This can be determined from the focal length of the lenses and the distance of the object from the camera. By measuring the angle between the line perpendicular to the direction of motion of the film and a line joining successive pictures of the moving object, it is possible to

determine the velocity of the image from the velocity of the film. The velocity of the film can be accurately determined by throwing on it flashes of light from a vibrating tuning fork. By this method, the velocity of an object can be obtained with an accuracy of at least 1 per cent.

The camera consists of a drum for carrying the film, a focal plane shutter drum, several lenses arranged in a line parallel to the axis of the drums, a motor for driving the drums, a tuning fork for timing the film, and a magnetically operated shutter. The focal plane shutter drum has slots so arranged that exposures are made by the different lenses in succession. The shutter drum rotates in the opposite direction from the film drum, and with a speed several times as great. The lenses should all have the same focal length and be placed at the same distance from the film.

The camera has been used to take pictures of projectiles in flight. With five lenses, 250 pictures per second have been taken. By increasing the number of lenses, the number of pictures can be increased. It should be useful whenever it is desired to study objects which are moving with high velocity.—*Notes from the U. S. Bureau of Standards.*

British National Defense

The attitude of the British labor cabinet toward national defense is clear-cut and defined. The undersecretary of the air ministry is a professed pacifist, and so also are many other members of the government, but they do not intend to allow their personal predilections or prejudices to stand in the way of the safety of the country. As a matter of fact, the labor party has never urged disarmament for Great Britain, irrespective of what other nations might do. It has aimed, and still aims, at international disarmament as a means of realizing its motto, "No More War," but it has common sense enough to perceive the folly of abandoning the only means that insures national safety as long as the rest of the world remains under arms. * * *

Thus the labor government added yet another to its growing list of parliamentary victories. Its members are winning confidence because they are proving themselves to be Britons first and partisans after. They refuse to sacrifice the national interest to party claims or catchwords, and in so doing are displaying the highest political wisdom. The longer they continue that line of conduct the more solidly will they establish themselves with the country.—*Washington Post.*

Possibilities of Electrical Developments in Japan

In Japan, the electrical industry is potentially the most important of all its industrial activities. Up to the time of the earthquake more money was being invested in this industry than in any other. The country is especially poor in coal and petroleum resources, so its manufacturing plants have been more or less dependent upon hydroelectric power and the ability of the Japanese to meet competition in the world market will depend to a great extent upon the future development of its hydroelectric resources.

In addition to furnishing cheap power for the manufacturing industries of the country, the electrical industry has also been a great factor in raising the standard of living of the Japanese people. A relatively large part of the energy produced is used for lighting purposes, and the foreigner traveling through out-of-the-way parts of Japan is surprised to find electric lights in small and almost

inaccessible villages. Out of about 10,000 cities and towns in Japan proper, 75 per cent are supplied with electricity in one form or another.

The numerous short, swift rivers found in Japan have caused the development of electricity by water power to far outstrip that produced by steam, especially during the past decade. In 1910 the amounts produced by steam and by water power were about the same, but at the end of 1919 out of a total of 572,000 kilowatts produced by commercial light and power companies, 487,000 kilowatts were generated by water power, while only 94,000 were being produced by steam. The total production of all plants, including private and government, during 1919 amounted to 1,133,000 kilowatts or about one-sixteenth that of the United States for the same period. The amount of paid-up capital invested in electrical enterprises at the end of 1919 amounted to 762,123,000 yen, as compared with 169,201,000 yen at the end of 1910. The number of companies increased during that period from 191 to 581.—*Power Plant Engineering.*

Panama Fire Control Installation

The army fortifications appropriation act for the fiscal year 1922 contained an appropriation of $25,000 for the construction of fire-control stations, the purchase and installation of accessories therefor, and for subaqueous sound and flash ranging apparatus and their development at the Panama Canal. It was intended to spend it at the Atlantic entrance to the Panama Canal. There was a great deal of preliminary work which had to be done, including some experimentation on the spot, before the money could be spent. This situation, helped by decisions of the comptroller general, resulted in the money reverting to the Treasury. The system consists of four stations with observing rooms and plotting rooms and the necessary electrical connections. The four stations are estimated to cost about $18,000, and the electrical connections will take the balance. The advantage of that fire-control system, over the systems which have been installed in other places in continental United States, is such that it will permit a very much greater flexibility of fire by these batteries. There are four 12-inch long range guns, with a maximum range of 27,500 yards. They are the last additions to the armament. The remainder of the armament consists of 14-inch guns and 12-inch mortars. The temporary fire control installation which has been put in enables the fire of all the guns at the entrance to be concentrated or distributed with great facility.—*Army and Navy Register.*

Enemy Airplanes Brought Down by American Antiaircraft Units

American antiaircraft units, operating in France, brought down 59 enemy airplanes. The first plane was brought down by the 52nd A. A. Battery east of Verdun, May 18, 1918. This battery also fired the first shot against hostile aircraft, April 18, 1918. The other 58 enemy planes were brought down in the four months prior to the signing of the armistice, 17 by five batteries of antiaircraft artillery and 41, which were low-flying planes, by two antiaircraft machine gun battalions of four companies each.—Prepared by *Statistics Branch, War Department General Staff, Washington.*

BOOK REVIEWS

The Crisis of the Naval War. By Admiral of the Fleet Viscount Jellicoe of Scapa, G. C. B., O. M., G. C. V. O. George H. Doran Co., New York, N. Y. 331 pp. 6 folding charts. Illustrated. Price $7.50

This is the second volume produced by Admiral Jellicoe since the termination of the World War. The first deals with the operations of the Grand Fleet during the period of Admiral Jellicoe's command. The present work details the British antisubmarine effort during the Admiral's tenure of office as First Sea Lord. The two constitute, in effect, a complete narration of the British Naval effort.

Admiral Jellicoe refers to the German submarine campaign as the gravest peril that has ever threatened the empire. The record, then, of the effort put forth by the Admiralty to counter this campaign should be of proportionate interest to students of naval warfare. Secrecy with regard to this phase of the war was essential both in respect to successes by the submarine and against the submarine. Thus, while one realized that the submarine was a menace, it is safe to say that very few appreciated the gravity of that menace as now delineated by Admiral Jellicoe. Equally the counter measures and the successes achieved thereby were more or less vague impressions in the minds of the majority. In both of these respects Admiral Jellicoe presents the true story, as viewed by the Admiralty, with frankness and clarity. As First Sea Lord and Chief of Naval Staff, he was preeminently qualified to survey this threatening page in British history.

In the first chapter of the book the organization of the Admiralty and in particular the changes therein necessitated by the current lessons of the war are discussed in detail.

In succeeding chapters the offensive and defensive operations against submarines are presented. Particularly are the difficulties of invention and supply of materiel for counter measures covered with great thoroughness. In a chapter on "Production" one finds a production program of small boats for antisubmarine work so tremendous that the gravity of the submarine question is driven home.

Not of least interest to Americans is the Admiral's description of the coordination between the British and American naval forces. The tribute paid by the British Admiral to Admiral Sims and the forces under him is not stinted.

Finally, in the "Sequel" the figures that alone measure the efficacy of the submarine and antisubmarine measures are given. These statistics show that the crisis of the Naval war was reached in the second quarter of 1917 when a total of 2,236,934 tons of shipping was lost due to submarine activities. Thereafter the losses declined steadily.

For those who wish to be thrilled by the account of naval actions this volume holds nothing but the few references to the heroic decoy ship engagements and occasional inter-submarine encounters. For those who desire the facts of the stupendous four-year battle between Germany beneath the waves and Britannia on and above them, "The Crisis of the Naval War" will offer a great amount of interesting and valuable instruction.

Automobile Blue Book, Volumes III and IV. Automobile Blue Books, Inc., Chicago. 1924. 9½"x 5½". Vol. III 706 pp. Vol. IV 794 pp. Price $3.00 per volume.

Contents of Volume III: Middle Western Automobile Blue Book. Complete touring data on 125,000 miles of automobile roads in Michigan, Ohio, Indiana, Kentucky, Illinois, Wisconsin, Minnesota, Iowa and Missouri.

Contents of Volume IV: California, Oregon, Washington, Idaho, Nevada, Utah, Arizona, New Mexico, Colorado, Wyoming, Montana, North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, Texas, Louisiana, Arkansas, Manitoba, Alberta, Saskatchewan and British Columbia; also the main highways to the Atlantic Coast.

These two volumes taken in conjunction with Volumes I and II, which have been reviewed in prior issues of THE JOURNAL, cover the whole of the United States as well as large sections of the adjacent provinces of Canada.

Comment on these books must of necessity be practically a repetition of what has been said of the two previous volumes. Each volume carries the thousand dollar insurance policy, though a clause in the policy precludes the payment of more than one death benefit, regardless of the number of volumes a person may purchase. These volumes have the same arrangement of the folded general map in a transparent faced holder which may be used as a bookmark, as well as the same careful maps and minute description of routes.

Volume IV is especially interesting as it shows the main highways leading west from Boston, New York, Philadelphia and Washington, as well as all the country west of the Mississippi River, and includes large scale insert maps and descriptive matter covering the Yellowstone and Glacier National Parks.

The Great Game of Politics. By Frank R. Kent. Doubleday, Page and Co., New York.

This book is of especial interest at this time because a presidential election is to be held this year and because of the wholesale investigations being conducted by Congress. It is very easy to read, the style is reportorial. It is an exceedingly interesting, well written book. Its chief merit lies in the fund of information it contains on "The Great Game of Politics."

The author tells how a precinct boss can control six hundred votes by actually delivering thirty-five at the polls. He tells how Government power flows from a few individuals through the local boss up to the bigger and bigger bosses until they elect Presidents and write Federal laws. No muckraking—just a plain statement of truth from a man whose large practical experience and plentiful opportunity for observation has made him thoroughly familiar with his subject. The reader obtains an accurate and clear conception of the party machine, its factors and functions, its methods and scope. The good and evil features of machine politics are clearly stated. He tells where the money comes from that is required for the nomination and election of the average party candidate, how that money is spent, and what obligations the party and candidate incur by accepting it. He discloses how powerful corporations, associations and interests influence national and state lawmaking—and above all he emphasizes repeatedly that the only cure for political ills, the one way to beat the machine, is a more active and intelligent interest in political affairs by the electorate. Voters must have enough interest to register, to vote in general elections, and above all to vote in primary elections, for the secret of the strength of the party machine is in control of the primaries.

The R. O. T. C. Manual. By P. S. Bond, E. B. Garey, O. O. Ellis, T. L. McMurray and E. H. Crouch, Book Department, St. John's College, Annapolis, Maryland, 1923. 6¼"x 9⅜". Column I, Freshman Course, $1.60; Volume II, Sophomore Course, $1.60; Volume III, Junior Course, $2.00; Volume IV, Senior Course, $2.00. Junior Manual, $1.60.

The four volumes comprising the set of the R. O. T. C. Manual, with the Junior R. O. T. C. Manual, are among the most serviceable books that the average officer can have in his professional library. While the present edition is published by the Book Department of the St. John's College, they are arranged along the same line as the "Red, White and Blue Manuals" and the "New Military Library," which have been of considerable service to the army at large during the past few years. The authors, P. S. Bond, E. B. Garey, O. O. Ellis, T. L. McMurray and E. H. Crouch, have had large experience in compiling data of this character, and the clear and logical manner in which the present books are written, and the illustrations, which are plentifully sprinkled through all of the volumes, will be of immense value. As an example of the care which has been used in compiling the illustrations, a set entitled "Stripping of the Browning Automatic Rifle," consists of a series of thirty small sketches which furnish almost a moving picture of each detail of the operations. Following this is a series of thirty more showing the assembling. One criticism which might be made is that the set has no index, though a very complete table of contents may be a fairly satisfactory substitute.

This set as a whole should appeal particularly to the Reserve or National Guard officer who may not have the facilities to keep as thoroughly in touch with the minutae of his profession as the Regular Army officers.

Frederick W. Taylor (Father of Scientific Management). By Frank B. Copley. Harper's, New York, 1923. 6¼"x 9". Two volumes, 495 pp. and 480 pp. Price $10.00.

This biography is both the life story of a remarkable engineer who will probably be ranked with the greatest men in history, and also a clear statement of how he worked out the principles and methods of handling men, and why such methods work.

Taylor was a great leader, who preferred peace, but was a first-class fighting man. Miss Ida Tarbell says of him, "Mr. Taylor never seemed to me more of a gentleman than when he was swearing." Besides being intrinsically interesting, his life for many years was connected professionally and by friendships with the Army and Navy. One long chapter is given wholly to his work with the Army, and is mostly devoted to General Crozier's introduction of scientific management into the arsenals, and the various successes and oppositions it met. And another chapter is given wholly to Taylor's connection with the Navy. All of that is of both historical and present interest to the Services.

But the book's treatment of management is even more interesting than such biographical and historical matters. Taylor's methods and principles of managing men aimed at achieving the greatest harmony and thus the largest results, and are based on justice and square dealing that is the opposite of coddling and slackness. For years Taylor commended West Point and Annapolis as the best sort of college yet developed.

The author, Copley, is a skilled writer who has by long study of Taylor acquired Taylor's pungent speech and his clear comprehension of the principles of handling men. So he writes a book that reads more entertainingly and easily than a novel, and at the same time is a remarkably sound and directly useful discussion of the Army officer's chief duty, the hardest of all duties, handling men.

Warfare by Land and Sea. By Eugene S. McCartney, Ph.D., University of Michigan. Marshall Jones Co., 212 Summer St., Boston. 5"x 7½". 203 pp. Illustrated. Cloth. Price $1.50.

The author of "Warfare by Land and Sea" has written an extremely scholarly and interesting work. No matter how many new inventions or implements of warfare man has made since War became a science, strategy and tactics are still fundamentally the same. We are shown the Greeks under Alexander developing the science of strategy, and Caesar teaching discipline and training recruits very much as our own men were trained in camps during the World War.

One noteworthy example is made of the fact that the only battle during the World War in which an entire army was destroyed by the enemy, was based on plans and tactics formulated nearly 2100 years before. This was the battle of Tannenberg where Hindenburg followed the plans used by Hannibal in the battle of Cannae.

This book is of especial interest to students of war plans, but others will find much to enjoy in its pages. Trench warfare is by no means a modern development and even air attacks had their prototypes in the huge towers used by the ancients against cities which were besieged. Tear-gas, smoke screens, barrage fire and tanks were all employed in their embryo states by the ancient Greeks and Romans.

The development of sea fighting has never been of as much interest to the historian, but here the changes while great, are not as remarkable as might be supposed.

The author has used many references in the making of his book and there are numerous notes in the back. Colonel W. K. Naylor, U. S. A., has written the very excellent preface, and there are some good reproductions of the old bas-reliefs of ancient fighting.

"Calvin Coolidge." By Hon. R. M. Washburn. Small, Maynard and Company, Boston, 1923. 150 pp. Price $1.50.

The author of "Calvin Coolidge" has written more in the vein of a hero-worshiper than a critic. However, the book gives a very interesting picture of a man little known to the average reader. The book is full of amusing incidents, starting with an anecdote of President Coolidge in his cradle, and continuing up to his succession to the White House. It reveals a human quality that is very attractive. His political life is given in detail from the time he first served as Councilman in Northampton. Mr. Coolidge has held public office during twenty-one of the past thirty years.

One chapter is devoted almost entirely to the so-called Police Strike in Boston, which as Mr. Washburn says, did not "make Coolidge," only showed the nation his qualities as a law enforcing governor. Credit is given to Mr. Stearns of Boston and Mr. Curtis for the part they have played in fostering Mr. Coolidge's political life.

As the author says, the story told in "His First Biography" is one of quality and not of quantity, and the book is comparatively short, being merely an attempt to picture the man's character as found by his friends. Showing that his coldness is really an intense diffidence with strangers, coupled with a moral strength that is remarkable.

"Calvin Coolidge" is a book to be read with interest by anyone wishing an insight to the outstanding political figure in America today.